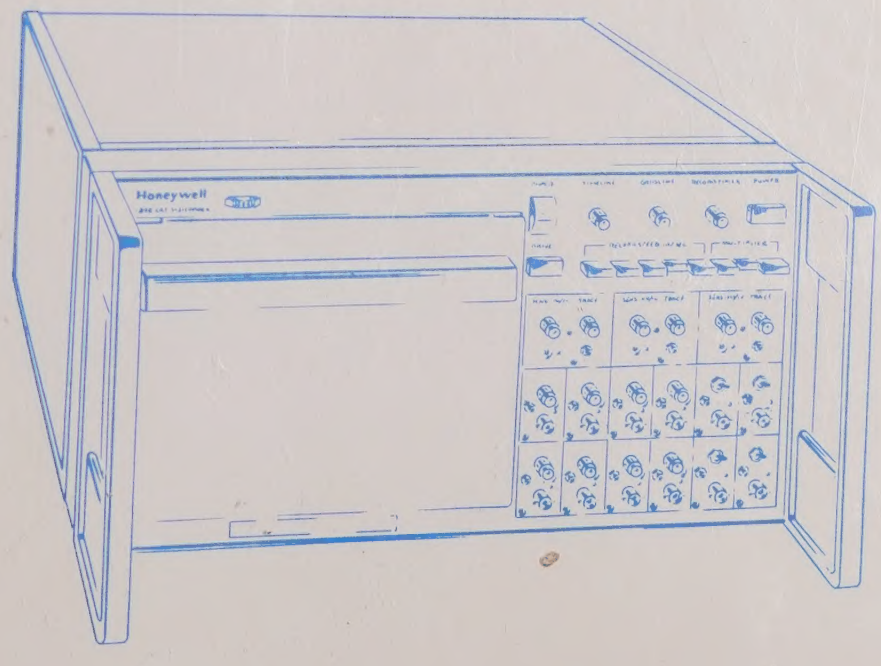
Technical Manual

MAINTENANCE INSTRUCTIONS FOR

CRT VISICORDER MODEL 1858



Honeywell TEST INSTRUMENTS DIVISION
P.O. BOX 5227 • DENVER, COLORADO • 80217

16781227 - 001

ADDENDUM TO

TECHNICAL MANUAL 16781227-001F

MODEL 1858 CRT VISICORDER

This addendum provides coverage for the 16779569-002 Trace Identifier Circuit Card Assembly. If your instrument does not have this assembly, disregard this addendum.

Page 6-20. Table 6-4

Change part number of index number 2 to 16779569-002.

Page 6-37. Table 6-8

Change part number of A3A2 to 16779569-002.

Change C10 to: Capacitor, Fixed, Ceramic Dielectric, 270PF, ±10%, 500 VDC Vendor, 81349; Vendor part number, 831-000X5F0-271K; Honeywell part number, 16761824-027; Qty, 1.

Page 7-15. Figure 7-7

Change the value of C10 to 270PF, ±10%, 500 VDC.

HONEYWELL INC. - Test Instruments Division - P.O. Box 5227 - Denver, Colorado - 80217
16781227-001T - December, 1980

Technical Manual

MAINTENANCE INSTRUCTIONS FOR

CRT VISICORDER MODEL 1858

NOVEMBER 1980

NOTICE

This technical manual is prepared in accordance with standards of good commercial practice. It is not intended in whole or in part to satisfy specific requirements of military or government specifications. Preparation of contents to such specifications will be quoted on request.

Honeywell TEST INSTRUMENTS DIVISION
P.O. BOX 5227 • DENVER, COLORADO • 80217

16781227 - 001R - 150 - November, 1980 - Printed in U.S.A.

Warranty

The company warrants all equipment purchased from and/or manufactured by it or bearing its nameplate to be free from defects in workmanship and material, under normal use and service as follows: (a) equipment not installed by the Company which (1) is returned transportation prepaid to the Company's originating factory within 12 months after date of shipment, and (2) is found by the Company's inspection to be defective in workmanship or material at the Company's option will be repaired or replaced free of charge and return-shipped lowest-cost transportation prepaid; and (b) equipment installed by the Company which is within 12 months after date of installation by the Company and found by the Company's inspection to be defective in workmanship or material, at the Company's option will be repaired or replaced free of charge. If inspection by the Company does not disclose any defect in workmanship or material, the Company's regular service charges will apply. Items specifically excluded from the 12 month warranty and which will not be repaired or replaced free of charge include flash tubes, galvanometer lamps, tubes, fuses, batteries, and similar components subject to wear or burnout through usage. Magnetic tape recording heads, cathode ray tubes, and similar components are excluded from the 12 month warranty, and will be repaired or replaced according to the terms of the particular contract. The foregoing warranty does not apply to contracts for repair, maintenance, or calibration. WITH EXCEPTION OF THE TWELVE MONTH WARRANTY SET FORTH ABOVE, THE COMPANY MAKES NO EXPRESS WARRANTIES, NO WARRANTIES OF MERCHANTABILITY, AND NO WARRANTIES WHICH EXTEND BEYOND THE DESCRIPTION ON THE FACE HEREOF. In no event will the Company be responsible for consequential damages of any nature whatsoever.

HONEYWELL INC. - Test Instruments Division
Rev A 5/73

Warranty

1858 FIBER OPTIC CATHODE RAY TUBE

1858 Serial Number 2908 and
all units produced thereafter.

The Fiber Optic Cathode Ray Tube installed by Honeywell in a Honeywell 1858 Oscillograph is warranted from date of shipment from Honeywell's Denver factory or other Honeywell service facility on prorated use basis, to be free from defects in material and workmanship for 1 year or 1000 hours of operation whichever occurs first.

Failures due to physical damage or damage resulting from misuse or customer misadjustment are specifically excluded from this Warranty.

If the tube should fail prior to 1000 hours of operation within the first year from date of shipment from Honeywell's Denver factory, or other Honeywell repair facility, a replacement will be made at a material charge proportional to the used part of the 1000 hour warranted life. This expended portion will be calculated to the nearest 100 hours, with no charge for failures occurring within the first 50 hours of use. Except on 1858 Oscillograph units that are still under the original factory warranty, installation charges will be made on all tube replacements.

DATA: Typical CRT gun life = 5000 hours
Typical Phosphor life = 2500 hours

7/3/75

HONEYWELL INC.
TEST INSTRUMENTS DIVISION
DENVER, COLORADO

FOREWORD

This manual provides full operation and maintenance instructions for the Honeywell Model 1858 CRT Visicorder. The manual contains installation, operation, theory of operation, maintenance, parts lists, and schematics.

Each type of signal conditioning plug-in module that may be used with the Model 1858 is supported by an individual technical manual containing operation and maintenance information for the module only. Space has been provided in this binder to allow the user to insert the module manual(s) after receipt of a specific system configuration.

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WARNING

In those situations where the source of the data signal to a plug-in module is capable of delivering more than 42.4 volts peak or more than 15 watts, the user must select interconnecting cables that are Underwriter's Laboratories, Inc. labeled, classified FR-1, and suitable for the potentials and currents of the test circuits. This must be done for continued protection against shock hazard and fire hazards.

Refer to individual module manuals for instruction on wiring of rear panel mating connectors.

WARNING

The chassis of this instrument is connected to earth ground through the ground wire in the power cord. Care must be taken when measuring a grounded power source to insure that the high side of the source is not connected to the measuring instrument ground. If the high side is connected to instrument ground a shock hazard and instrument damage may result.

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SECTION 1

INTRODUCTION

1-1. GENERAL

This section describes the Honeywell Model 1858 Cathode Ray Tube (CRT) Visicorder and it's operating specifications. The discussion includes options to the basic unit and a brief list of the signal conditioning plug-in modules available to complete the recording system. Complete details on the plug-in modules are contained in their respective manuals.

This instrument is designed, except as noted in the detail specification published herein, for operating in a laboratory-type environment. It can be used in non-laboratory applications with adequate environmental protection.

1-2. DESCRIPTION

The Model 1858 CRT Visicorder is the basis for a multichannel recording system which uses the light from a fiber-optic cathode-ray tube (FO-CRT) to record up to 18 simultaneous data channels on moving photosensitive paper. The recorder provides the housing and power supply functions for the separately purchased plug-in signal conditioning modules and also provides trace display, paper transport, reference signals (gridlines and timelines), and identifying (trace identification) signals for the overall system.

The plug-in modules, which are discussed in separate manuals, convert input data signals into time referenced unblanking signals synchronized with the FO-CRT beam sweep. The modules control the relative positions and physical amplitude of the recorded traces.

Figure 1-1. Model 1858 CRT Visicorder with Modules

All data and reference line signals recorded by the Model 1858 are presented on the 8 inch by 0.2 inch FO-CRT. The fiber-optics faceplate conducts the light from the phosphor to the moving photosensitive paper with negligible diffusion. All signals are presented to the CRT in the form of an unblanking signal which allows signal crossovers or convergence without affecting the accuracy of the recorded traces. Each sweep of the CRT beam unblanks briefly to print the instantaneous position of each trace. The 50 kHz sweep rate gives the record the appearance of unbroken traces for static or slowly varying traces. Rapidly transiting signals use a collected sampling system built into each module to unblank the CRT to connect significant sweep to sweep changes in the instantaneous position of the signal trace. Focus, intensity, and sweep rate are automatically controlled by the recorder.

The paper transport incorporates a dc servo-controlled drive motor to provide a wide range of operating speeds from 0.1 to 120 inches per second. The use of adding and multiplying speed pushbuttons allows the selection of more than 42 discrete speeds within the range.

The recorder unit generates signals to allow the signal conditioning modules to synchronize with the CRT beam. The recorder also generates signals to print gridlines, timelines (optional), and trace identification (optional) on the record.

1-3. SIGNAL CONDITIONING PLUG-IN MODULES

A variety of signal conditioning plug-in modules may be used with the Model 1858 CRT Visicorder. The specific type of module used for a particular data channel depends on the requirements of the input data signal. The following list presents the model numbers and nomenclature of the currently available modules.

Model Number	Nomenclature
1881-HGD*	High Gain Differential Module
1882-LGD*	Low Gain Differential Module
1883-MPD	Medium Performance Differential Module
1884-IFM	Interface Module
1885-SGC*	Strain Gage Control Module
1886-TCU*	Thermocouple Control Unit & Microvolt Amplifier Module
1887-TCD*	Tape Compatible Differential Amplifier Module
1889-FVC*	Frequency to Voltage Converter Module

*These modules require two adjacent slots for each module.

For information concerning recent module development or unique applications, contact your Honeywell representative.

1-4. OPTIONS

The Model 1858 may be ordered with the following factory installed options:

A. TIMELINES

The timeline option adds the capability of printing lines perpendicular to the direction of record motion to aid in frequency measurements or event sequence determination. The timelines may be printed at manually or automatically selected intervals or controlled externally. The TIMELINE switch and external input BNC connector are installed on all Model 1858 Visicorders even through the option is not included.

NOTE

If the timeline option is not included, the gridline feature will not operate in the interrupted mode.

B. TRACE IDENTIFICATION

The trace identification option adds the capability of printing channel numbers along the right edge of the record and trace markers near the corresponding signal traces.

C. INTERNAL TAKE-UP

The internal take-up option provides the capability of spooling the record inside the recorder after it is exposed which is convenient for long or continuous recordings that do not have to be analyzed immediately. The internal take-up also provides protection of the recording from high ambient light levels.

D. LATENSIFIER

The latensifier (Honeywell Part Number 16775753-003) is a light source used to bring out the latent image on the record more rapidly. It contains two white fluorescent lamps with on-off pushbuttons, and one ultraviolet lamp with separate on-off pushbuttons. The latensifier is mounted on the left handle of the recorder and receives its power through the connector FOR 58L on the front panel.

E. RACK MOUNTING

The rack mounting kit (Honeywell Part Number 16776101-002) contains rack slides and attaching hardware required to install the recorder in a standard 19-inch RETMA rack. Installation instructions are contained in Section 2.

F. MODEL 1870 AMPLIFIER HOUSING

The Model 1870 Amplifier Housing provides for the use of up to 18 additional single-slot signal conditioning plug-in modules. This brings overall system capacity to 32 single-slot modules. This option is not provided on Underwriter's Laboratory listed instruments.

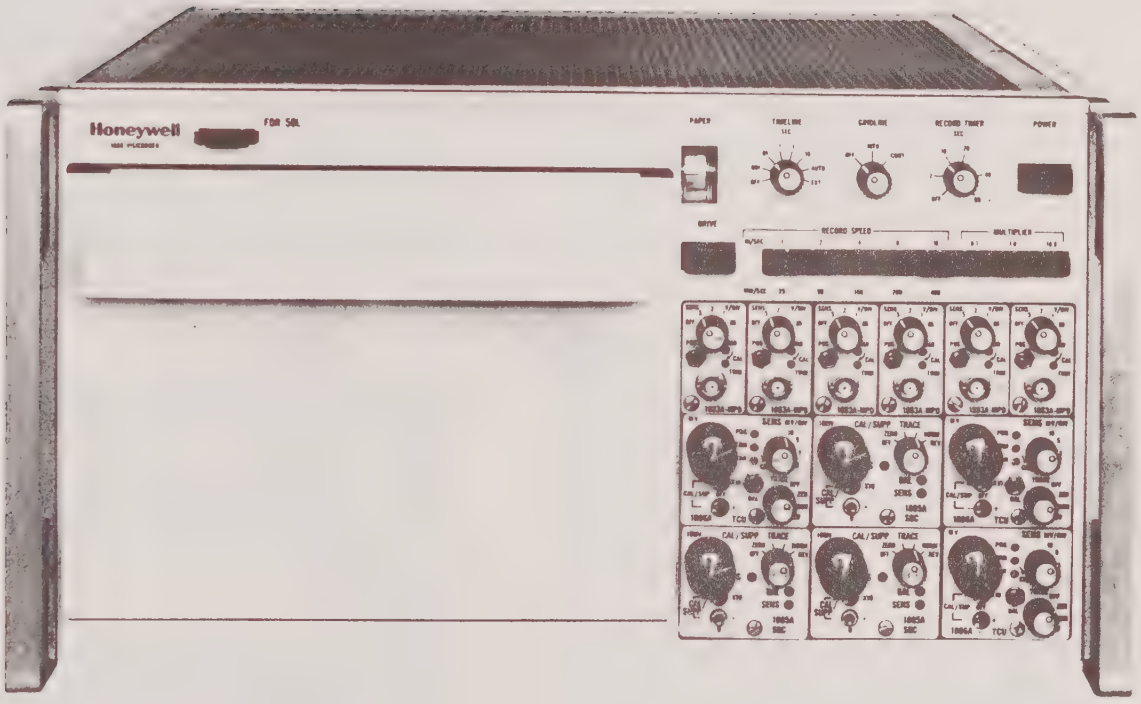
Honeywell

Oscillographic Recorders

VISICORDER MODEL 1858

PRODUCT INFORMATION

Fiber-optic CRT recorder complete with self-contained signal conditioning...a compact 18 channel Graphic Data Acquisition System. Expandable to 32 channels.



Underwriters Laboratories Listed

Outstanding Features

- 18 channel system in single 8¾ inch (22.3 cm) high package
- 32 channel system in a 14 inch (35.6 cm) high package
- Front panel plug-in signal conditioning modules
- Inertialess recording — no moving elements, no styli
- DC — 5 kHz response at up to 7.2 inch (18.3 cm) trace amplitude
- 100 μV-300V input sensitivity, to 300V common mode
- No trace overshoot
- Sharp static traces without high frequency "wipe-out"
- Direct writing, 8 inch (20 cm) record width, 200 ft (61 m) record length
- 5-interval timing system with accentuated tenth line and 0.1% accuracy
- Time-interval marker
- Auto-linearized for increased data accuracy
- Numbered trace identification
- Wide-range, dc-servo drive system
- 0.1 to 120 inch/sec (2.5 to 3000 mm/sec) record speeds
- 42 discrete record speeds via binary addition push-buttons
- Remote drive and speed control
- Internal record takeup
- Automatic record-length control
- 120/240V, 50-400 Hz power, switch selectable
- Lightweight, low power consumption
- Rack or table mounting
- Wide selection of signal-conditioning modules available
- Easy to use as an oscilloscope — just add signal input connections

Product Description

The Model 1858 Graphic Data Acquisition System is not just another oscillograph — it offers a totally new concept in acquiring and recording analog data. State-of-the-art design, combined with reduced complexity and integrated circuitry, makes the Model 1858 the first self-contained, yet compact, graphic data acquisition system with a selection of up to 18 recording channels. When combined with the accessory Model 1870 housing, the channel capacity can be increased to 32. In addition to being versatile and easy to use, the system is exceptionally accurate and reliable.

In a lightweight package only 8¾ inches (22.3 cm) high, the Model 1858 outperforms other systems requiring a full rack of equipment. This means that the system can be used with laboratory accuracy either in the field or in a fixed location. Adaptability to different ac line voltages and insensitivity to line frequency variations allow world-wide usage. Or, by using an inexpensive power inverter, the system may be battery operated.

Records that are relatively insensitive to normal room light are produced without inks, powders, styli, electrostatic charges, liquids, electrical arcs or chemical vapors. Ultraviolet light is generated by a cathode-ray tube and directed through a special fiber-optic faceplate onto photosensitive direct print paper. Thus, recordings are produced immediately without the need for inconvenient and time-consuming wet processing or toner application.

Front panel openings on the 1858 accept up to 18 individual signal-conditioning modules. A family of these plug-in modules is available to cover a wide variety of applications. Among these are: high-, low- and medium-gain differential amplifiers, a strain-gage control, a thermocouple control, a frequency to voltage converter, and a module to simultaneously condition signals for the 1858 and instrumentation tape recorders. These signal conditioners allow recording within the dc to 5 kHz range and accept input signals from 100 μV to 300V. Calibrations in millivolts and volts-per-division make the Model 1858 as easy to operate as an oscilloscope. Also, since the plug-in signal conditioning modules do not have to supply power to drive pens or galvanometers, they have been miniaturized using state-of-the-art integrated circuits.

All plug-in modules contain an analog-voltage-to-time converter. The converter produces a pulse with a duration proportional to the amplitude of the input signal. These pulses unblank the CRT which is swept at a fixed rate of 50 kHz. To avoid a dotted trace presentation at high frequencies, a uniquely designed memory circuit connects the unblanked samples to yield a continuous trace.

To assist in measuring the amplitude and time of recorded signals in calibrated increments, the Model 1858 places longitudinal amplitude reference lines and transverse timelines on the record. Also available, as an option, is a trace numbering and identification feature. This feature identifies the signals and prints the corresponding channel numbers on the edge of the paper.

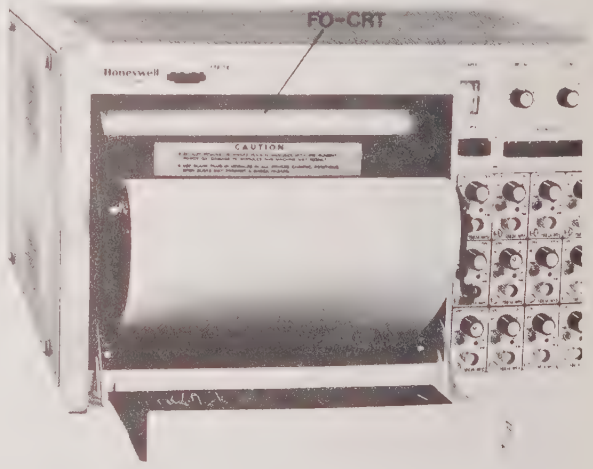
A wide range (1200:1) dc servo system allows a selection of paper speeds from 0.1 to 120 inch/sec (2.5 to 3000 mm/sec) in 42 discrete steps. As a further convenience in handling the recording paper, a built-in record takeup unit is offered as an option.

All operator controls are on the front panel. These include a power switch, speed selector pushbuttons, record drive switch, timing interval selector, gridline selector and automatic record timer. Indicators are also provided for power on, drive on and paper supply.

Standard Features

Electronic Housing

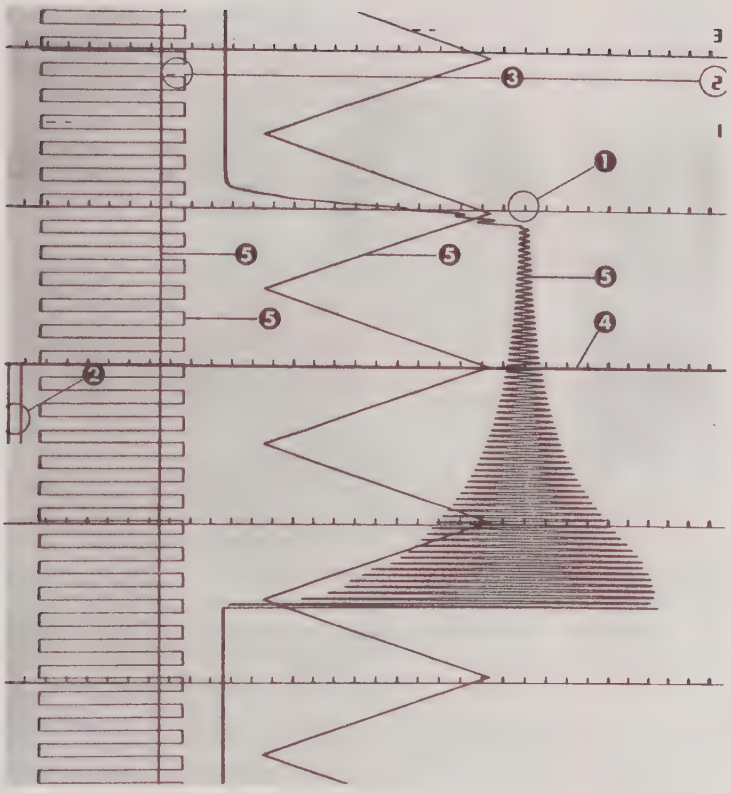
A single, 8¾ inch (22.3 cm) high housing encloses a fiber-optic, cathode-ray tube (FO-CRT), power supplies, control circuits, reference line circuits, and record drive servo. The housing also accepts up to 18 individual plug-in signal-conditioning modules.



Fiber-optic Cathode-ray Tube

The specially designed FO-CRT faceplate consists of about 10 million glass fibers — each only a few microns in diameter — fused together within a 0.2 by 8 inch (5 by 200 mm) area. These fibers provide efficient transfer of ultraviolet radiations from the phosphor inside the faceplate to the photosensitive paper. This permits extremely fast writing speeds and excellent trace resolution.

Since the recording paper is in intimate contact with the faceplate, additional optical elements are not required. Intensity and focus are factory preset and, since adjustments are rarely required, controls are not on the front panel. To prolong phosphor life, the recording area is gradually moved in both axes. This movement is so slow that it in no way detracts from the accuracy or readability of the recording.



❶ Interrupted Gridline

❷ Time Interval Marker

❸ Numbered Trace Identification

❹ Timelines

❺ Data Traces

Note: Graph as shown is 55% of original size.

Gridlines

To assist in measuring signal amplitudes in calibrated increments, the Model 1858 can place longitudinal lines each 0.2 inch (5 mm) across the paper. The lines are accentuated at 1-inch (25 mm) intervals and appear across 7.2 inch (18.3 cm) of the record.

The gridlines may be continuous or interrupted, as selected via a front panel switch. The switch also allows the gridlines to be turned off for applications where signal levels are not important.

Interrupted lines appear for approximately 1/16 inch (1.6 mm) following each timeline, retaining amplitude references without cluttering the record. The interrupted gridline feature is operable only when the timing line option is included and is in use.

Record Drive

Recording paper is driven over a 1200:1 speed range by a servo system consisting of a dc drive motor, tachometer generator and associated electronics — totally eliminating gears and clutches. In addition to providing a wider selection of paper speeds than mechanical gear systems, the servo drive system is quiet, reliable, easily maintained and allows increased flexibility for remote or computer control.

Speed selection is controlled from the front panel by five pushbuttons of 1, 2, 4, 8 and 16 inch/sec (25, 50, 100, 200 and 400 mm/sec) and three multiplier pushbuttons of x0.1, x1 and x10. By depressing the switches in binary addition, 42 discrete speeds can be selected.

a. 0.1 to 1.6 inch/sec in 0.1 inch/sec increments (2.5 to 40 mm/sec in 2.5 mm/sec increments)
b. 1 to 16 inch/sec in 1 inch/sec increments (25 to 400 mm/sec in 25 mm/sec increments)
c. 10 to 120 inch/sec in 10 inch/sec increments (250 to 3000 mm/sec in 250 mm/sec increments)

Remote control of drive on-off and CRT unblanking is provided by a rear panel BNC connector. The LOCAL/REMOTE selector switch on the rear panel locks out actuation by other than the selected mode. Remote actuation is TTL compatible or by a single pole, single throw switch closure.

By applying 0.008 to 10V to a rear panel connector, the entire speed range of 0.1 to 120 inch/sec (2.5 to 3000 mm/sec) can be remotely programmed in continuously variable or discrete steps.

Automatic Record Length

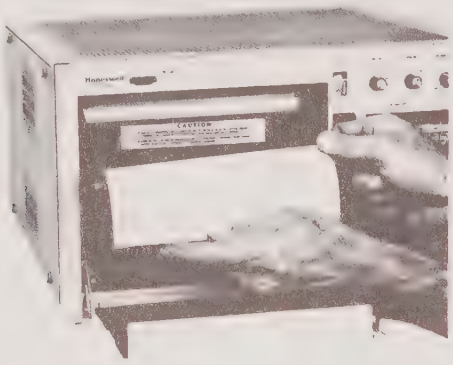
A front-panel switch allows manual or automatic control of recording time. When the switch is set to off, recording time is manually controlled by the drive switch. For automatic control, the record timing switch is continuously adjustable from 1 to 60 seconds. By setting the timer and then depressing the drive switch, either local or remote, the record is driven for the selected amount of time and stopped automatically. The drive switch must be released and pressed again to initiate another recording cycle.

The Model 1858 Visicorder oscillograph, in combination with the signal conditioning modules, are Underwriters Laboratories Inc. listed under both UL 544, Listed Medical Equipment and UL 1244, Listed Electrical Measuring Equipment. When ordering, the user must state his choice of either Medical or Industrial listing since differences exist in construction and panel marking. Most modifications and accessories are also U.L. accepted. See page 21 for ordering information and modification/accessory U.L. acceptability.

The Underwriters Laboratories Inc. listing applies to standard units only, and only when used with U.L. accepted accessories. Units specially modified will be built

to the UL configuration specified on the order but the "UL Listed" markings will be omitted where such modifications would violate the UL listing.

Paper Loading



Recording paper can be loaded in seconds, without threading. Simply pull the platen forward, insert the supply spindle in the new roll, drop the roll into the cradle and push the platen back into position. A paper supply meter on the front panel indicates the approximate amount of paper remaining.

Ambient Light Cover

A hinged door protects the photosensitive paper from ambient light and functions with or without the record takeup option.

Recording Paper

Records are relatively insensitive to normal room light and remain stable indefinitely when stored. Recording papers are available from Honeywell, as well as several manufacturers of photosensitive materials. When copying is required for inclusion in technical reports, some of these materials are available for reproduction by office copying equipment, photostating, etc., while others are available for wet chemical processing. Paper improvements are frequent, so contact your Honeywell representative for the latest information.

Optional Features (Factory Installed Only)

Timelines

The timeline feature can be operated manually, automatically or externally, and it includes time interval markers.

For manual control, a front panel switch produces ±0.1% accurate timelines across the paper at intervals of 0.001, 0.01, 0.1, 1 or 10 seconds. Each tenth line is accentuated to facilitate record analysis. The timelines also can be slaved to external signals at rates up to 1000/sec.

In the auto mode, timelines are automatically printed at predetermined intervals, as determined by the recording speed selected:

Paper Speed		Timing Interval (sec)
Inch/sec	mm/sec	
0.1 to 0.7	2.5 to 17.5	1
0.8 to 7	20 to 175	0.1
8 to 70	200 to 1750	0.01
80 to 120	2000 to 3000	0.001

Another benefit of the timeline option is automatic time marking. One or more coded marks are placed perpendicular to each accentuated timeline, near the left edge of the paper, as shown in the sample recording.

In this manner, the timeline interval and record travel speed at which a recording was made can be determined without having to annotate the record. The timing marks are disabled when the timelines are externally triggered. The time mark coding is:

Mark	Seconds
none	0.001
1	0.01
2	0.1
3	1
4	10

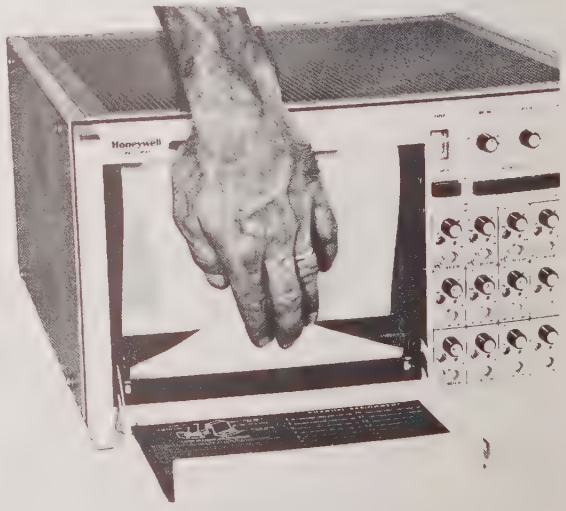
Numbered Trace Identification

For positive identification of each data channel, this option prints the channel number on the right edge of the paper and places two dash marks, 1/16 inch (1.6 mm) to the right of the corresponding data trace (see sample record). Channels are identified in sequence approximately every 0.5 inch (12.5 mm), regardless of paper speed.

When a recording channel is not equipped with a conditioning module, no identification mark or number is printed. Dual signal conditioning modules require two plug-in slots and are, therefore, assigned two channel numbers. In this case, only the lower of the two channel numbers is printed.

Internal Record Takeup

This option consists of a mechanism that internally spools up records of any length to 200 ft (61 m). The option accommodates the full range of paper speeds and eliminates the need for inconvenient accessory devices. No additional motors or clutches are required because the takeup spool is driven by a toothed belt connected to the paper drive servo.



Depending on the method of loading the paper, records can be either taken up or fed out of the Model 1858. Loading the takeup spindle is simple, and no adhesive tape or threading is necessary.

After loading the supply as previously described, lay the takeup spindle against the paper, push the spindle into the slots provided, pull the paper snugly against the takeup spindle and start the paper around the spindle with the drive system operating at a speed of 0.2 inch/sec (5 mm/sec).

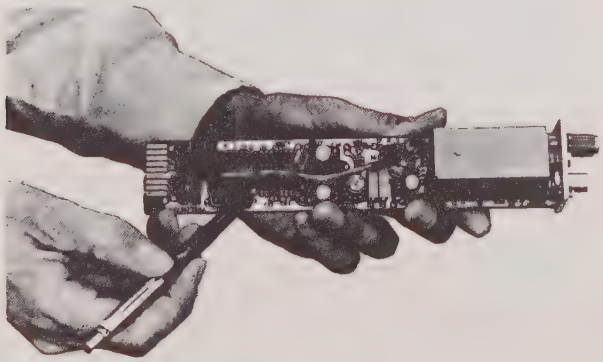
Removal of a full or partial roll is equally convenient: simply tear the paper across its width, push the spooled paper backward and upward in the guides and withdraw the roll. The takeup spindle is then pushed out from the spooled up paper and may be used immediately for succeeding records.

Signal Conditioning Modules

A variety of plug-in modules are available to accept input signals from 100 μV to 200V per major division from voltage and transducer sources with common mode voltages to 300V. All operating power is drawn from supplies within the electronic housing. As a result, the modules are compact — up to 18 single-width, 9 dual-width, or a combination of both can be accommodated in the basic Model 1858 — up to 32 single-width, 16 dual-width with the add-on Model 1870 housing.

Sensitivity calibrations are in volts/division (V/DIV) rather than gain to simplify operation. Each module has a switch to turn its display on or off without disturbing the established baseline position. And, a position control allows the baseline of the trace to be placed anywhere across the entire width of the paper. Each module is capable of producing a recording at any amplitude up to 7.2 inch (18.3 cm) and at frequencies from dc to 5 kHz.

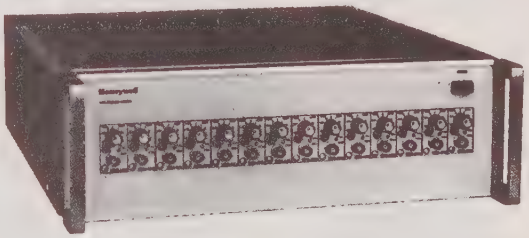
Signal input connections are made through five-pin MS-type connectors on the Model 1858 rear panel. However, some modules offer a choice of either rear-panel or front-panel (BNC) input via a jumper-pin change within the module.



In addition to providing signal amplification, some modules provide gage excitation, suppression and calibration for applications such as strain gage and temperature measurement. Although the modules are completely self-contained for most measuring needs, appropriate preconditioning is required for certain transducers, such as piezoelectric devices. Complete specifications for all of the signal conditioning modules start on page 10.

Additional Channel Capacity

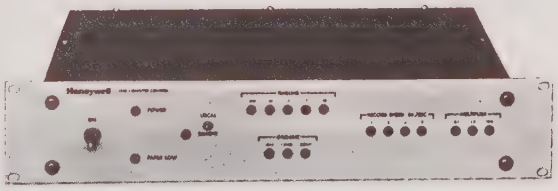
The Model 1870 add-on 14 channel housing, described and shown in the right-hand column of page 6, allows the Model 1858 channel capacity to be extended to 32 channels. Adding the housing requires that the Model 1858 be provided with interface connectors, available as a factory-installed option. Retrofit kits are also available for units not originally equipped with this option.



Model 1870 Add-on Housing

Remote Control

Remote on/off control of record drive and recording beam via a rear panel BNC is a standard feature. Remote control of record drive speeds, timelines and gridlines is available on special orders. Controls are logic compatible and may be actuated by switch closures or computer command. For specific information for your particular application, consult your Honeywell TID representative or request D-2429.



Computer/Manual Remote Control Interface Unit

Accessories

Rack Mounting Kit

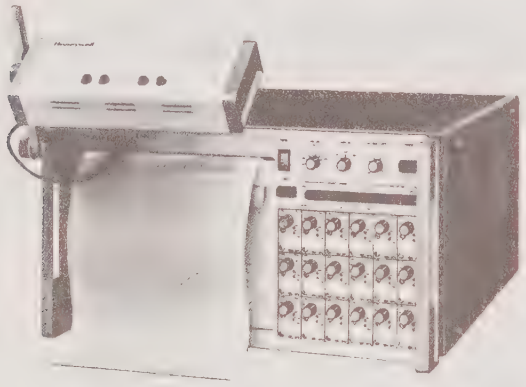
The Model 1858 is designed for both table and rack mounting. For rack mounting, an accessory kit is available. The kit consists of slide rails, front trim strips and mounting hardware. The slide rails fit into 25 inch (63.5 cm) deep standard EIA racks. Only 8¾ inches (22.3 cm) panel height is required to mount the Model 1858, including all options and accessories; 14 inches (35.6 cm) with the 1870 housing.

Latensifier Lamp Assembly

Printout-type recording paper used in the 1858 is exposed by ultraviolet light forming a latent image on the recording paper. The latent image appears as a trace when later exposed to light in the visible spectrum — ideally, fluorescent. The rapidity with which the trace will appear is proportional to the intensity of this secondary exposure.

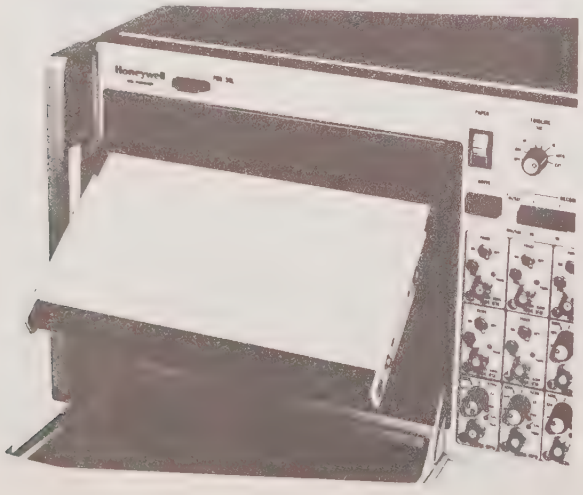
To aid in the forming of the latent image, a process commonly called "latensification," an adjustable latensifier lamp assembly is available for mounting on the front of the 1858. This assembly has cool-white fluorescent lamps, controlled by pushbutton switches, for normal record latensification at the slower record travel speeds. The lamps accelerate the latensification for the shortest possible trace appearance time.

Record qualities, such as contrast and writing speed, are degraded by rapid latensification. However, the user can readily select the best position and lamp combination for his particular needs.



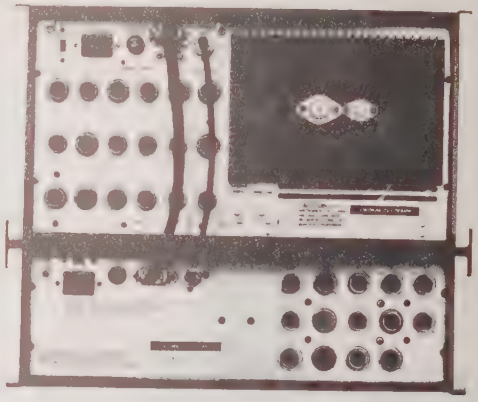
Writing Platen

Where it is desired to make pencil annotations on the record, or to observe the data before a record is spooled onto the internal takeup, an accessory writing platen is available. The platen may be used either in the spill-out or take-up mode. The hinged front cover door must be left open when this accessory is used. The platen is attached to the 1858 after the paper is loaded, but before the takeup is engaged, by simply pushing it into place where it is retained by two knurled thumb-screws. Installation time is only a few seconds.



Amplifier Housing Model 1870

The Model 1870 Amplifier Housing allows the Model 1858 Visicorder oscillograph to record up to 32 data channels simultaneously. The 1870 consists of a single housing, mounted beneath the Model 1858, that will accept 14 single-width, 7 dual-width (or combinations) of the 1880 series signal conditioning modules for the Model 1858. The housing contains its own power supplies and therefore does not increase the load on those of the Model 1858. Interface between the 1870 housing and the 1858 is via two rear-panel connectors and cables.



To use the 1870 housing with the Model 1858, the 1858 must have both the "9" (trace identifier) and the "H" (housing) options in its model code (e.g., 1858-T7**9H**). Otherwise, in addition to the 1870 housing, a retrofit kit for the Model 1858 is required. Kits are available to allow field retrofit of the Model 1858 to accommodate the 1870 housing.

Like the Model 1858, the 1870 housing is supplied for table mounting. Accessory slide kits are available for mounting in standard EIA racks. Although the 1858 and the 1870 are individual units, the 1870 must be mounted below, and mechanically connected to the 1858 for both physical and electrical (noninductive grounding) reasons. The 1870 housing is supplied with the appropriate hardware for this purpose.

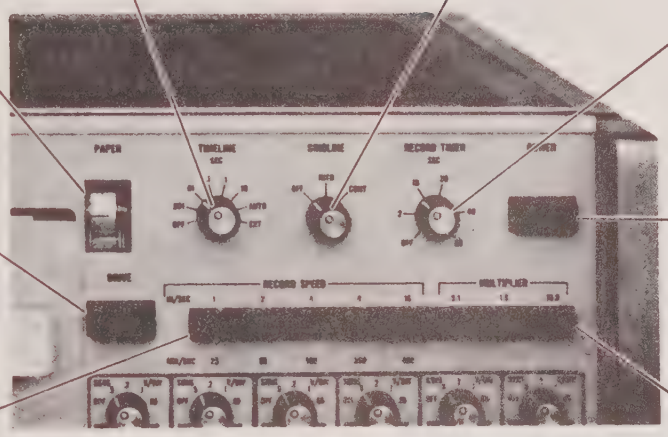
The numbered trace identifier system of the Model 1858 is designed to accommodate the full 32-channel capability of the 1858-1870 combination, and to provide the interface between the 1870 and the 1858. Jumper pins on the trace identifier circuit card restrict the capability to 18 channels when the 1870 is not used. A 32-channel trace numbering circuit card is supplied with the retrofit kits for earlier Model 1858's, and for later Model 1858's that do not have the trace identifier option installed.

Data signal inputs are on the rear panel of the 1870, as they are on the 1858, and the connectors and wiring configurations are identical to those of the Model 1858.

The 1870 housing requires no operating controls other than the power on-off switch. All recording functions are provided by the Model 1858, with the appropriate signals (video, retrace, line, clock, ramp, count, control) between the 1870 and the 1858 accommodated by the two interface cables at the rear of both units.

All performance characteristics of the Model 1858 and the 1880 series signal conditioning modules are retained when operated with the 1870 housing. Wattage is 25W with no modules installed.

Controls and Indicators



TIMELINE (optional)
Eight position rotary switch selects timeline intervals of .001, .01, .1, 1 and 10 seconds, plus off, automatic and external synchronization positions.

GRIDLINE
Three position rotary switch allows selection of gridlines off, interrupted, or continuous.

PAPER
Indicator shows approximate amount of recording paper remaining.

RECORD TIMER
Rotary control selects manual or automatic record length (time); automatic is 1 to 60 seconds.

DRIVE
Latching pushbutton switch energizes servo record drive system. Unblanks CRT for recording; glows green when on.

POWER
Pushbutton switch turns power on for standby; glows red when on.

RECORD SPEED
Five additive pushbutton switches select 1, 2, 4, 8 or 16 inch/sec (25, 50, 100, 200, 400 mm/sec) in steps of 1 inch (25 mm) per sec.

MULTIPLIER
Three pushbutton switches multiply the selected record speed by 0.1, 1.0 or 10.0 (120 inch/sec) (3000 mm/sec) max.

CONTROLS ON REAR PANEL

LINE VOLTAGE
Slide switch adapts system to 120 or 240V, 50-400 Hz power.

REMOTE DRIVE
Toggle switch selects local or remote record drive.

Specifications

General

Recording System ..... Single fiber-optic, cathode-ray tube in direct contact with direct-print photographic paper produces all data traces, timelines, gridlines and trace identification recordings. Single 8¾ inch (22.3 cm) high cabinet houses paper supply, paper takeup, drive system, fiber-optic cathode-ray tube, power supplies and all associated electronics, as well as openings for signal conditioning modules for up to 18 data channels.

Recording Medium ..... Direct print photographic oscillograph recording paper, spec 2 [spooled emulsion side out on 1⅛ inch (28.6 mm) ID core].

Record Width ..... 8 inch (200 mm)

Record Capacity ..... 3¼ inch (82.6 mm) max roll diameter; 100 ft (30 m) standard base, 200 ft (61 m) extra thin base.

Recording Channels ..... 18 max single-width modules, 9 max dual-width modules, or combinations.

Operating Specifications

(All specifications apply after 30 minute warmup.)

Power Required:

Voltage ..... 107/127V, 50-400 Hz or 214/254V, 50-400 Hz by rear switch selection. Transformer taps permit operation down to 100 or 200V, 50-400 Hz.

Wattage ..... 100-350, depending on options, paper speed and number of channels installed. See table on page 9 for typical values.

Frequency Response ..... DC-5 kHz sinewave, 15 kHz squarewave; except as otherwise limited by signal conditioning module selected.

Input Data Sampling Rate..... Approximately 50 kHz (sweep time 15 μsec; flyback time 5 μsec).

Accuracy
Linearity
Sensitivity
Drift
Noise
Common Mode Voltage
Common Mode Rejection
Overload Recovery
Filtering
Crosstalk
..... See signal-conditioning module specification sheets

Trace Dimensions ..... Max 0.012 inch (0.3 mm) dynamic, 0.020 inch (0.5 mm) static (plus applicable signal conditioning noise spec).

Trace Amplitude ..... Max 7.2 inch (18.3 cm) pk-pk or single deflection throughout dc-5 kHz frequency range.

Trace Positioning ..... Controls on signal conditioning modules permit electrical positioning of any channel at any point across the record.

Trace Off ..... Switch on signal conditioning modules permits any channel to be turned off the record. When turned on, trace restores to previously established base position.

Phosphor Burn Protection..... Area of horizontal sweep is continuously moved up and down CRT face while both gridlines and data are continuously moved horizontally approximately 0.18 inch (4.5 mm) to maximize phosphor life. Vertical period is approximately 450 sec, horizontal period is approximately

2000 sec. Beam is blanked while drive switch is off. Operator does not have access to intensity or sweep rate controls.

Tube Life (rated) ..... CRT gun, 5000 hr (power-on); phosphor, 2500 hr (drive switch on).

Recording Intensity Control ..... Internal control for initial setting and periodic maintenance. No change of intensity required over full writing or paper speed range. Automatic intensity reduction at paper speeds <1 inch/sec (<25 mm/sec).

Gridlines

Selection ..... Front panel control allows gridlines (amplitude reference) to be turned off, on intermittently or on continuously. Intermittent lines appear for approximately 1/16 inch (1.6 mm) adjacent and perpendicular to each timeline.

Spacing ..... Nominal 0.2 inch (5 mm), each fifth line (1 inch, 25 mm) accentuated. Gridline spacing may vary slightly to compensate for nonlinearity of CRT.

Accuracy ..... Within ±0.5% full scale relative to data. Gridlines vary in spacing to compensate for nonlinearity of CRT. Combined accuracy of gridlines and data traces, relative to each other, will be within the accuracy and linearity specifications of that listed for the signal conditioning module used.

Temperature Coefficient of Spacing ..... <±0.075% /°C

Line Width ..... Minor lines 0.010 inch (0.25 mm) max; accentuated lines 0.020 inch (0.5 mm) max.

Record Drive System

Type ..... Wide range dc servo with 1200:1 speed range. No gears or clutches.

Speed Selection ..... Five front panel pushbutton speed selector switches of 1, 2, 4, 8, 16 inch/sec (25, 50, 100, 200, 400 mm/sec) plus three multiplier pushbutton switches of X0.1, X1, X10 give 42 discrete speed steps. Speeds of 1, 2, 4, 8 inch/sec (25, 50, 100, 200 mm/sec) may be engaged in combination, producing binary additive speeds of:

X0.1 range: 0.1-1.6 inch/sec in 0.1 inch/sec steps (2.5-40 mm/sec in 2.5 mm/sec steps)

X1 range: 1-16 inch/sec in 1 inch/sec steps (25-400 mm/sec in 25 mm/sec steps)

X10 range: 10-120 inch/sec in 10 inch/sec steps (250-3000 mm/sec in 250 mm/sec steps)

Remote Drive Control ..... Rear panel BNC connector and Local/Remote switch. Switch locks out actuation by other than selected mode. TTL compatible or actuation by single-pole, single-throw switch closure. Must sink 1.6 mA.

Remote Speed Control ..... By releasing front panel speed multipliers and providing an externally supplied voltage of +0.008 to +10.0 V, speed may be varied from 0.1 through 120 inch/sec (2.5-3000 mm/sec). Input impedance is 2 kΩ ±1%. Polarity positive with respect to ground.

Acceleration Time ..... To 80 inch/sec (2000 mm/sec) <250 msec; to 120 inch/sec. (3000 mm/sec) <500 msec.

Speed Markings ..... Front panel marked in inch/sec and mm/sec.

Recording Periods (continous) ..... 200 ft (61 m) roll: 6.6 hr at 0.1 inch/sec (2.5 mm/sec); 20 sec at 120 inch/sec (3000 mm/sec). 100 ft (30 m) roll: 3.3 hr at 0.1 inch/sec (2.5 mm/sec); 10 sec at 120 inch/sec (3000 mm/sec).

Accuracy ..... ±5% with 1, 2, 4, 8 or 16 inch/sec (25, 50, 100, 200, 400 mm/sec) speed selector pushbuttons engaged; ±7% with additive speed selected, over full voltage and environmental range. Typically ±3% at nominal voltage and environment.

Auto Record Length Control ..... Front panel control selects from 1 to 60 sec drive time. Automatic control can be manually overridden by releasing drive switch. The cycle will be restarted when drive switch is reactuated.

Record Takeup (option) ..... Internal. Will takeup and spool full capacity of supply roll at all drive speeds, either on continuous or interrupted basis, over full environmental range. Records can be made with or without takeup as desired.

Timing System (option)

Timeline Intervals ..... Timelines recorded across min of 7.2 inch (18.3 cm) of record width each 0.001, 0.01, 0.1, 1 and 10 sec with each tenth line accentuated.

Selection ..... Front panel rotary switch permits manual or automatic selection, external synchronization, and off.

Accuracy ..... Within ±0.1% ±10 μsec over full environmental range.

Timeline Width ..... Minor: 0.010 inch (0.25 mm) max; accentuated: 0.025 inch (0.6 mm) max.

Time Interval Marker ..... Coded marking perpendicular to each accentuated tenth timeline gives indication of timing interval selected, either manually or automatically. Disabled when timeline selector switch is in the "external" position.

Coding is:

no mark = 0.001 sec
1 mark = 0.01 sec
2 marks = 0.1 sec
3 marks = 1 sec
4 marks = 10 sec

Automatic Time Interval ..... With the timeline interval switch in the automatic position, the timeline interval is automatically established with front panel record travel speed selection:

0.1-0.7 inch/sec (2.5-17.8 mm/sec) = 1 sec timing
0.8-7 inch/sec (20.3-178 mm/sec) = 0.1 sec timing
8-70 inch/sec (203-1780 mm/sec) = 0.01 sec timing
80-120 inch/sec (2030-3048 mm/sec) = 0.001 sec timing

External Timeline Synchronization:

Max Repetition Rate 1000/sec

Input Requirements ..... DTL/TTL/CTL/RTL compatible or contact closure through rear panel BNC connector. Source must be able to sink 3 mA. Timeline is triggered on negative-going transition from +2.4 to −0.4V. Signal must remain lower than +0.4V for >100 nsec.

Max Safe Input Voltage ..... DC + ac peak, ±60V; 20V rms

Accuracy ..... Timeline will lag external signal by no more than 20 μsec.

Trace Identification (option)

Trace Marking ..... Each channel installed is identified in sequence by two dash lines placed adjacent to the trace, perpendicular to record travel. Lines are approximately 0.075 inch (2 mm) in length, spaced 0.100 inch (2.5 mm) apart and within 0.065 inch (1.6 mm) of the trace.

Trace Numbering ..... The channel number of each marked trace is placed on the righthand edge of the record in time registration with the trace marker. Characters are 7 bar system presentation having dimensions of approximately 0.125 inch (3.1 mm) high and 0.075 inch (2 mm) wide. Gridlines and timelines are inhibited within 0.065 inch (1.6 mm) of trace number.

Identifier Sequence Spacing ..... Each 0.5 ±0.1 inch (12.5 ±2.5 mm) for each succeeding trace. Vacant signal-conditioning channels are not identified. When double-width modules are installed, only the lower of the two channel numbers is identified.

Environmental

Temperature:

Operating ..... 0 to +50°C (32 to 122°F)

Nonoperating ..... −55 to +60°C (−67 to 140°F)

Rate of Change ..... 10°C (18°F) per minute max.

Humidity:

Operating ..... 5-95% relative, noncondensing (except as otherwise stated in signal conditioning module specifications).

Nonoperating ..... 5-95% relative, noncondensing

Altitude:

Operating ..... to 10,000 ft (3048 m)

Nonoperating ..... to 50,000 ft (15,240 m)

Vibration:

Operating ..... Designed and tested to requirements of MIL-T-21200G, para. 3.2.19.4 (except 5-15 Hz, 0.06 inch (1.5 mm) pk-pk; 15-25 Hz, 0.04 inch (1 mm) pk-pk; 25-55 Hz, 0.0032 inch (0.08 mm) pk-pk.

Nonoperating ..... Designed and tested to meet requirements for transportation and packaged shipping.

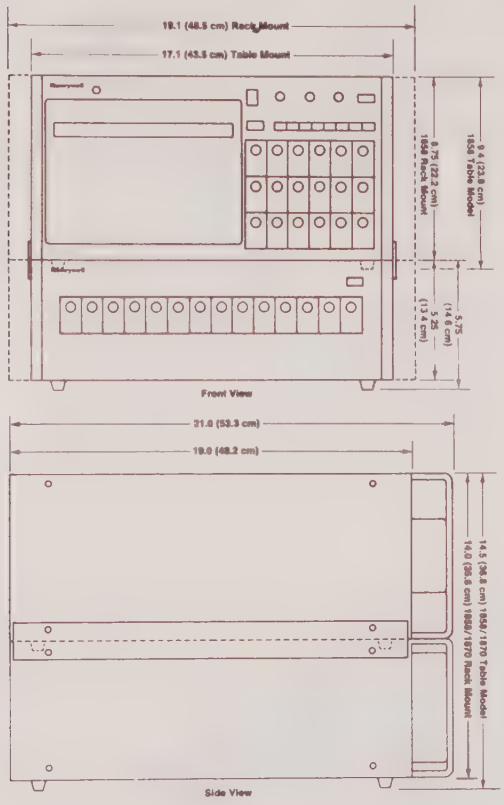
Shock ..... Designed and tested to meet requirements for normal bench handling, transportation and packaged shipping.

Packaging

Size (Model 1858):

Table Model ..... 9.4 inch (23.8 cm) high x 17.1 inch (43.5 cm) wide x 21 inch (53.3 cm) deep.

Rack Mount ..... 8.75 inch (22.2 cm) high x 19.1 inch (48.5 cm) wide x 21 inch (53.3 cm) deep.


19.1 (48.5 cm) Rack Mount
17.1 (43.5 cm) Table Mount
8.75 (22.2 cm) 1858 Rack Mount
9.4 (23.8 cm) 1858 Table Model
5.25 (13.4 cm)
5.75 (14.6 cm)
Front View
21.0 (53.3 cm)
19.0 (48.2 cm)
14.5 (36.8 cm) 1858/1870 Table Model
14.0 (35.5 cm) 1858/1870 Rack Mount
Side View

Size (Model 1858 with 1870 Housing).

Table Model ..... 14.5 inch (36.8 cm) high x 17.1 inch (43.5 cm) wide x 21 inch (53.3 cm) deep.

Rack Mount ..... 14 inch (35.5 cm) high x 19.1 inch (48.5 cm) wide x 21 inch (53.3 cm) deep.

Weight:

Model 1858 ..... Less signal conditioning modules or accessories, 65 lb (29.5 kg).

Model 1858/1870 ..... Less signal conditioning modules or accessories, 95 lb (43 kg).

Signal Conditioning Modules:

Single Width ..... 5 oz (141.7 gm) [1883A-MPD, 1884-IFM].

Dual Width ..... 10 oz (283.5 gm) [1881-HGD, 1882-LGD, 1885A-SGC, 1886A-TCU, 1887A-TCD, 1889A/B-FVC].

Power Requirements

Table of Typical Power Requirements* (120V, 60 Hz Reference)

Paper Drive (inch/sec)	Spill-out Mode (rms watts, no signal conditioning modules installed)	Take-up Mode (rms watts, no signal conditioning modules installed)
Off	91	91
0.1	104	110
1	110	120
10	123	135
50	164	197
80	188	230
120	248	306

Signal Conditioning Modules*

Type	Watts (rms)	Type	Watts (rms)	Type	Watts (rms)
1881	2.8	1883A	1.3	1886A	2.0
1882	2.9	1884	1.2	1887	2.8
		1885A	2.8	1889A/B	2.0

*Notes:

1. Peak currents typically 2-3 times the rms value, due to peak rectifiers used in system.
2. Peak "power-on" surge current, first cycle, is approximately 14A; steady state reached in approximately 180 msec.
3. At line frequencies of 50 and 400 Hz, wattage approximately 5% greater than above figures.

Reliability

The Honeywell Model 1858 has been designed to provide the maximum in reliability and minimum maintenance. The design program included Quality Assurance design review and a mean-time-between-failure (MTBF) prediction.

To aid the user in determining maintenance requirements, the estimated MTBF of any 1858 system configuration can be determined from the table below.

This prediction was performed using MIL-HDBK-217A failure rates (paragraph 7.0) and the K-Factors for GROUND environment. A detailed parts application review (a review to ensure that all parts are correctly applied and that parts are not overstressed by voltage, current, power or temperature) was performed.

Based on the fact that all the parts are correctly applied and are not overstressed, the prediction was performed in accordance with MIL-HDBK-217A, para. 4.5, utilizing specific parts count on part types operating at an ambient temperature of 50°C. The stress ratios selected were those that are typical of Honeywell's derating practice.

The estimated mean time between failure assumes an exponential distribution. The failure rate allocations for the specific system elements are summarized in the table.

MTBF TABLE

Component	Number of Units(n)	Failures per 10^6 Hrs(λ)	$n\lambda$
Basic 1858 (less options & signal conditioning modules)	_____	361.82	_____
1870 Housing	_____	90.91	_____
Trace Identification Option	_____	16.60	_____
Timeline Option	_____	14.90	_____
1881-HGD Signal Conditioning Module	_____	63.19	_____
1882-LGD Signal Conditioning Module	_____	58.76	_____
1883-MPD Signal Conditioning Module	_____	29.88	_____
1884-IFM Signal Conditioning Module	_____	20.74	_____
1885-SGC Signal Conditioning Module	_____	62.18	_____
1886-TCU Signal Conditioning Module	_____	43.00	_____
1887-TCD Signal Conditioning Module	_____	58.14	_____
1889-FVC Signal Conditioning Module	_____	66.22	_____
		Total =	_____

Example:

1858 with timeline option and three 1884 modules:

1 x 361.82 = 361.82
1 x 14.90 = 14.90
3 x 20.74 = 62.22
Total = 438.94

MTBF = 1/438.94 x 10^{-6}

MTBF = 2,278 hr

MTBF (in hrs) = $\frac{1}{\text{Total} \times 10^{-6}}$

Signal Conditioning Modules

A selection of plug-in signal-conditioning modules gives the 1858 Graphic Data Acquisition System exceptional adaptability to unique or changing test and measurement problems. While each signal-conditioning module is designed to accommodate a wide range of input signals, certain measurements may require signal conditioning having different characteristics, or it may be desired to increase channel capacity. In either case, it is only necessary to insert the appropriate signal-conditioning module into the 1858 system and to connect the signal-input leads.

Each signal-conditioning module is complete with all controls required for its particular function, an analog-input section and a voltage-to-time (PDM) converter; thus, no adjustments or changes to other portions of the 1858 system are required when adding or changing channels. Blank panels are available for unused channel positions.

Frequency response of the 1858 system and its signal conditioning modules is primarily dependent upon "sample-rate error". Sample-rate error is that introduced as a result of the sweep excursion time in relation to the rate of change of the analog signal input and, therefore, increases as the signal-input frequency is increased.

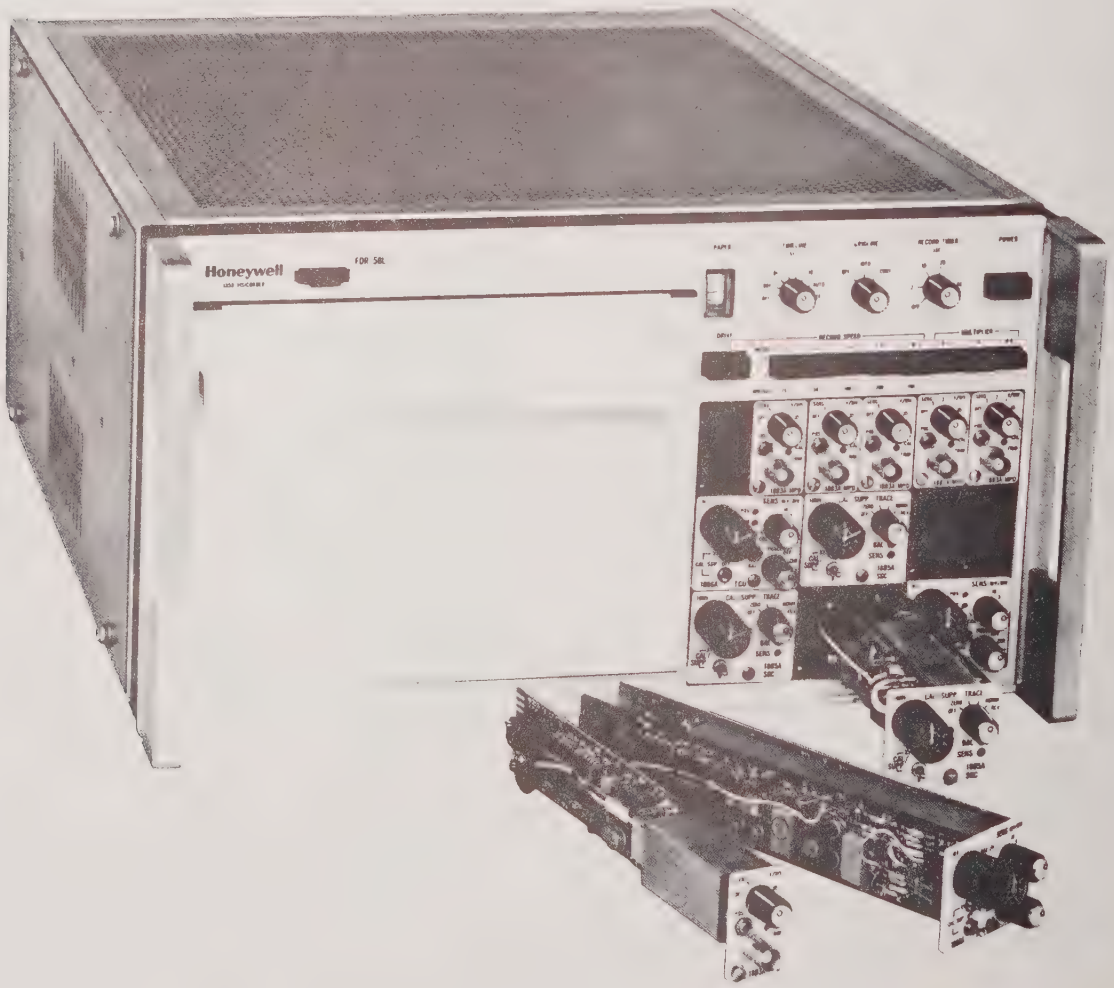
Due to the sampling system utilized in the 1858, transients of less than 20 μsec duration may or may not be recorded, depending upon the occurrence of the transient in relation to the start of the horizontal sweep.

Signal inputs to the signal-conditioning modules are made through 5-pin, MS-type connectors on the rear panel of the 1858. The system is fully wired and chassis connectors are provided for 18 channel capacity. One mating connector (Amphenol P/N 165-33, Honeywell P/N 16773755-001) is furnished with each signal conditioning module purchased.

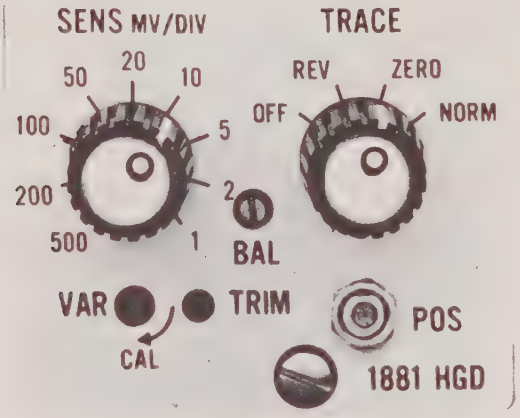
The Models 1883A*-MPD and 1884 IFM signal conditioning modules are provided with auxiliary BNC connectors on the front panel to permit access for tests without disturbing the rear input.

Complete specifications for each signal-conditioning module are on the following pages.

**The 188X and 188XA modules are identical when used in the 1858. The 188XA has the amplified (or attenuated) analog signal routed to the rear of the module for use in the Model 1871 amplifier system. This output is not accessible in the Model 1858*



Model 1881–HGD High Gain Differential Amplifier Module



Description

The 1881-HGD is a high gain, floating and guarded dc amplifier, designed to accept low level input signals. System sensitivity is ±1 mV to ±1V/div (1 inch, 25 mm), with common mode voltage capability to ±300V peak. It occupies two paired module spaces (for example, channels 1 and 2) of the 1858 system.

If the module input is connected to a source that can deliver more than 1A, U.L. requirements state that a fuse with less than 1A rating and with sufficient current interruption capability be placed in series with the signal input leads.

Front Panel Controls

Sensitivity ..... 9 position rotary switch, with knob, to set the system sensitivity in calibrated steps.

Variable Sensitivity ..... Multiturn screwdriver-adjustable control to vary the amplifier sensitivity between calibrated steps and extends range to 1V/div.

Position ..... Multiturn screwdriver-adjustable control positions trace at any point across the record width.

Trace ..... 4 position rotary switch with knob: OFF position removes signal and eliminates trace by placing it off-scale. NORMal position produces right-to-left trace deflection (facing the 1858) with positive signal on the non-inverting input terminal. REVerse position reverses trace deflection. ZERO position shorts output, ahead of the position control, to remove signal influence for trace positioning.

Trim ..... Multiturn screwdriver-adjustable control permits precise setting of system sensitivity.

Balance ..... Multiturn screwdriver-adjustable control allows the amplifier dc output to be zeroed (with no input signal).

Specifications

Input:

Type ..... Floating and guarded; preferred connection is guard lead connected to signal low lead at signal source.

Impedance ..... >10 MΩ shunted by <120 pF

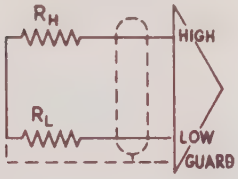
Offset Current ..... 50 nA max

Max Safe Input Voltage ..... ±50V dc or peak ac

Max Safe Common Mode Voltage ..... ±300V dc or peak ac

Max Safe Combined Input and Common Mode Voltages ..... ±300V dc or peak ac

Source Resistance ..... All specifications apply for $R_H \leq 350\Omega$ and with resistance of R_L no greater than the following:



R_L ohms	Sensitivity mV/div
10	1
20	2
50	5
100	10
200	20
350	50-1000

Sensitivity:

Steps ..... 1, 2, 5, 10, 20, 50, 100, 200, 500 mV/div

Accuracy ..... Adjustable to within ±0.5% full scale, relative to gridlines (trim control). Ratio accuracy between steps within ±2.0%, typical ±0.5% at ≤25°C (77°F) and ≤50% R.H.

Linearity ..... Within ±0.5% full scale, relative to gridlines.

Stability ..... Within ±0.05% full scale, per degree C, relative to gridlines.

Frequency Response:

dc to 2 kHz ..... +0%, −3% max error

dc to 3 kHz ..... +0%, −5% max error

dc to 5 kHz ..... +0%, −12% max error

Drift ..... Distance on record per degree C relative to gridlines.

$$\text{inch} = 0.002 + \left(\frac{0.007}{\text{Sens. in mV/div}}\right)$$

$$\text{mm} = 0.05 + \left(\frac{0.175}{\text{Sens. in mV/div}}\right)$$

Noise (wideband):

1 mV/div sensitivity ..... <0.06 inch (1.5 mm) pk-pk, plus static trace width, on record.

2 mV/div sensitivity ..... <0.04 inch (1 mm) pk-pk, plus static trace width, on record.

5 mV/div sensitivity ..... <0.035 inch (0.9 mm) pk-pk, plus static trace width, on record.

10-1000 mV/div sensitivity ..... <0.030 inch (0.75 mm) pk-pk, plus static trace width, on record.

Common Mode Rejection, Typical (dc-60 Hz):

Sensitivity	≤ 25°C, ≤50% RH	≤ 50°C, ≤ 80% RH
1 mV/div	> 100 dB	> 80 dB
2 mV/div	> 94 dB	> 74 dB
5 mV/div	> 86 dB	> 66 dB
10-1000 mV/div	> 80 dB	> 66 dB

Crosstalk ..... Negligible

Overload Recovery ..... <1 msec to within 0.030 inch (0.75 mm) of final value for 10 times input overload. to a max of ±50V peak.

Filtering ..... Internal terminals for user installed components for one 12 dB/octave low pass filter.

Output ..... TTL logic level pulses with pulse duration proportional to input signal level for interfacing with 1858 system. No external outputs are provided.

Power ..... Draws all required power from 1858 system.

Environmental ..... Same as 1858 system except as stated above.

Model 1882–LGD Low Gain Differential Amplifier Module

Description

The 1882-LGD is a low gain, floating and guarded dc amplifier. It is designed to accept high level input signals, giving a system sensitivity of ±100 mV to ±200V/div (1 inch, 25 mm) to a maximum of ±300V, at common mode voltages to ±300V peak. It occupies two paired module spaces (for example, channels 1 and 2) of the 1858 system.

If the module input is connected to a source that can deliver more than 1A, U.L. requirements state that a fuse with less than 1A rating and with sufficient current interruption capability be placed in series with the signal input leads.

Front Panel Controls

Sensitivity ..... 10 position rotary switch, with knob, to set the system sensitivity in calibrated steps.

Variable Sensitivity ..... Multiturn screwdriver-adjustable control to vary the amplifier sensitivity between calibrated steps and extends range to 200V/div.

Position ..... Multiturn screwdriver-adjustable control positions trace at any point across the record width.

Trace ..... 4 position rotary switch with knob: OFF position removes signal and eliminates trace by placing it off-scale. NORMal position produces right-to-left trace deflection (facing the 1858) with positive signal on the non-inverting input terminal. REVerse position reverses trace deflection. ZERO position shorts output, ahead of the position control, to remove signal influence for trace positioning.

Trim ..... Multiturn screwdriver-adjustable control permits precise setting of system sensitivity.

Balance ..... Multiturn screwdriver-adjustable control allows the amplifier dc output to be zeroed (with no input signal).

Specifications

Input:

- Type ..... Floating and guarded, preferred connection is guard lead connected to signal low lead at signal source.
- Impedance ..... >1 MΩ shunted by <120 pF
- Offset Current ..... Negligible
- Max Safe Input Voltage ..... ±300V dc or peak ac
- Max Safe Common Mode Voltage ..... ±300V dc or peak ac
- Max Safe Combined Input and Common Mode Voltages ..... ±300V dc or peak ac

Source Resistance ..... All specifications for 0-1 kΩ, and with no more than 350Ω in low input lead.

Sensitivity:

- Steps ..... 0.1, 0.2, 0.5, 1, 2, 5, 10, 20, 50, 100V/div.
- Accuracy ..... Adjustable to within ±0.5% full scale, relative to gridlines (trim control). Ratio accuracy between steps within ±2.0%, typical ±0.5% at ≥25°C (77°F) and ≥50% R.H.
- Linearity ..... Within ±0.5% full scale, relative to gridlines.
- Stability ..... Within ±0.05% full scale, per degree C, relative to gridlines.

Frequency Response:

- dc to 2 kHz ..... +0%, −3% max error
- dc to 3 kHz ..... +0%, −5% max error
- dc to 5 kHz ..... +0%, −12% max error

Drift ..... <±0.003 inch (0.075 mm) on record per degree C, relative to gridlines, at any sensitivity setting.

Noise (wideband) ..... <0.010 inch (0.25 mm) pk-pk, plus static trace width, on record, at any sensitivity setting.

Common Mode Rejection, Typical (dc-60 Hz):

Sensitivity	≤ 25°C, ≤ 50% RH	≤50°C, ≤ 80% RH
0.1V/div	> 86 dB	> 80 dB
0.2V/div	> 80 dB	> 74 dB
0.5V/div	> 72 dB	> 66 dB
1V/div	> 66 dB	> 60 dB
2V/div	> 60 dB	> 54 dB
5V/div	> 52 dB	> 46 dB
10V/div	> 46 dB	> 40 dB
20V/div	> 40 dB	> 34 dB
50V/div	> 32 dB	> 26 dB
100V/div	> 26 dB	> 20 dB

Crosstalk ..... Negligible

Overload Recovery ..... <1 msec to within 0.030 inch (0.75 mm) of final value for 10 times full scale input overload, to a max of ±300V peak.

Filtering ..... Internal terminals for user installed components for one 12 dB/octave low pass filter.

Output ..... TTL logic level pulses with pulse duration proportional to input signal level for interfacing with 1858 system. No external outputs are provided.

Power ..... Draws all required power from 1858 system.

Environmental ..... Same as 1858 system except as noted above.

Model 1883A–MPD Medium Gain Differential Amplifier Module

Description

The 1883A-MPD is a medium-gain, differential dc amplifier. It is designed to accept moderately low level input signals, giving a system sensitivity of ±50 mV to ±1V/div (1 inch, 25 mm) at common mode voltages to ±15V peak. Internal jumper pins allow for disabling the rear input in favor of a front panel BNC input connector. It occupies a single module space in the 1858 system.

Front Panel Controls

Sensitivity ..... 5-position rotary switch, with knob, to set the system sensitivity in calibrated steps In OFF position, removes signal and eliminates trace by placing it off scale.

Variable Sensitivity ..... Multiturn screwdriver-adjustable control to vary the amplifier sensitivity between calibrated steps. At min setting, extends min sensitivity to 1V/div.

Position ..... Multiturn screwdriver-adjustable control positions trace at any point across the record width.

Trim ..... Multiturn screwdriver-adjustable control permits precise setting of system sensitivity.

Internal Controls

Balance ..... Single turn screwdriver-adjustable control allows the amplifier dc output to be zeroed (with no input signal).

Normal/Reverse ..... Internal jumper pins allow reversal of trace deflection. NORMal position produces right-to-left trace deflection (facing the 1858) with positive signal on the noninverting input terminal. REVerse position reverses trace deflection.

Input Selection ..... Internal jumper pins allow rear (MS) input to be disabled and input transferred to front panel BNC connector. BNC may be used in single-ended, grounded configuration only.

Specifications

Input:

- Type ..... Differential
- Impedance:
  - Differential ..... 1 ±0.01 MΩ shunted by <100 pF
  - Single-ended ..... Normal polarity: 1 ±0.01 MΩ shunted by <100 pF. Reverse polarity: 500 kΩ shunted by <100 pF.
- Max Safe Input Voltage ..... ±20V dc or peak ac
- Max Safe Common Mode Voltage ..... ±15V dc or peak ac
- Max Safe Combined Input and Common Mode Voltages ..... ±15V dc or peak ac
- Max Operating Common Mode Voltage ..... ±10V dc or peak ac
- Max Operating Combined Input and Common Mode Voltages ..... ±10V dc or peak ac
- Source Resistance ..... All specifications apply for 0-10 kΩ, with 0-1 kΩ unbalance, except as separately specified.
- Offset Current ..... 10 nA max

Sensitivity:

- Steps ..... 50, 100, 200, 500 mV/div.
- Accuracy ..... Adjustable to better than ± 0.5% full scale, relative to gridlines (trim control). Ratio accuracy between steps within ±1%.
- Linearity ..... Within ±0.4% full scale, relative to gridlines.
- Stability ..... Within ±0.02% full scale, per degree C, relative to gridlines.

Frequency Response:

- dc to 1 kHz ..... +0%, −0.5% max error
- dc to 2 kHz ..... +0%, −1.3% max error
- dc to 3 kHz ..... +0%, −3% max error
- dc to 5 kHz ..... +0%, −8% max error

Drift ..... <0.005 inch (0.125 mm) on record, relative to gridlines per degree C at any sensitivity setting.

Noise (wideband) ..... <0.016 inch (0.4 mm) pk-pk, plus static trace width, on record at any sensitivity setting.

Common Mode Rejection (dc-60 Hz) ..... No source unbalance, >54 dB; 1 kΩ source unbalance, >50 dB.

Crosstalk ..... <0.010 inch (0.25 mm) pk-pk, plus static trace width, on record at any sensitivity setting.

Overload Recovery ..... <1 msec to within 0.030 inch (0.75 mm) of final value for 10 times input overload, to a max of 20V peak.

Filtering ..... Internal terminals for user installed components for one 12 dB/octave low pass filter.

Output ..... TTL logic level pulses with pulse duration proportional to input signal level for interfacing with 1858 system. No external outputs are provided.

Power ..... Draws all required power from 1858 system.

Environmental ..... Same as 1858 system.

Note: Plug-in input attenuators are available to extend the input range to a max of ±200V dc or peak ac. For details, request D-2301.

Model 1884–IFM Interface Module

Description

The 1884-IFM adapts the 1858 system to signal sources (such as unique or existing signal conditioning units, voltage sources, etc.), where the source impedance is sufficiently low and the signal levels are sufficiently high that additional amplification and impedance matching are not required. The 1884-IFM consists only of the voltage-to-time converter portion of other signal conditioning modules. Sensitivity is ±1V/div (1 inch, 25 mm). The rear MS and front panel BNC connectors are connected in parallel in a single-ended, grounded configuration. It occupies a single module space in the 1858 system.

Front Panel Controls

Position ..... Multiturn screwdriver-adjustable control positions trace at any point across the record width.

Trace ..... 2 pole toggle switch. OFF position eliminates trace by placing it off scale.

Trim ..... Multiturn screwdriver-adjustable control permits precise setting of system sensitivity, range ±10%.

Specifications

Input:

- Type ..... Single ended, grounded
- Impedance ..... 3.74 ±0.5 kΩ shunted by <100 pF
- Max Safe Input Voltage ..... ±25V dc or peak ac
- Source Resistance ..... 1 kΩ max; 10Ω max when connected in parallel with other recording devices.

Sensitivity:

- Steps 1V/div
- Accuracy ..... Adjustable to within ±0.5% full scale, relative to gridlines (trim control).
- Linearity ..... Within ±0.4% full scale, relative to gridlines.
- Stability ..... Within ±0.02% full scale, per degree C, relative to gridlines.

Frequency Response:

- dc to 1 kHz ..... +0%, −0.2% max error
- dc to 2 kHz ..... +0%, −0.8% max error
- dc to 3 kHz ..... +0%, −1.8% max error
- dc to 5 kHz ..... +0%, −5% max error

Drift ..... ±0.002 inch (0.05 mm) on record relative to gridlines per degree C at any sensitivity setting.

Noise ..... <0.016 inch (0.4 mm) pk-pk, plus static trace width, on record.

Crosstalk ..... Negligible

Overload Recovery ..... <1 msec to within 0.030 inch (0.75 mm) of final value for 10 times input overload, to a max of ±25V peak.

Output ..... TTL logic level pulses with pulse duration proportional to input signal level for interfacing with 1858 system. No external outputs are provided.

Power ..... Draws all required power from 1858 system.

Environmental ..... Same as 1858 system.

1885A–SGC Strain Gage Control Module

Description

The 1885A-SGC provides a convenient means for making accurate strain gage measurements with the 1858 system. In addition to signal amplification, the 1885A-SGC provides gage excitation and balance as well as calibration and suppression of the input signals. Sensitivity is from 1 to 100 mV/div (1 inch, 25 mm). By changing internal jumper pins, the 1885A-SGC may also be used as a high-gain differential dc amplifier, with both calibration and suppression, for low-level inputs. Its ability to be used with strain gage, thermocouple or other low-level signals makes it an ideal choice where flexibility is required. It occupies two paired module spaces (for example, channels 1 and 2) in the 1858 system.

Operating Controls

Gage Excitation ..... Internal jumper pins for selection of gage excitation voltages of 2.5, 5, or 10V.

Balance ..... Front panel, multiturn screwdriver-adjustable control to cancel residual gage unbalance. May be disabled via internal jumper pins for other than strain gage applications.

Calibration/Suppression ..... Front panel, multiturn control with high-torque counting dial, calibrated from 0-10.00 mV. Applies a precise calibration voltage to the amplifier input for adjustment of system sensitivity when the TRACE switch is in the ZERO position. Front panel, toggle switch extends range to 100.0 mV. Separate front panel three-position toggle switch selects + or − polarity or off. With the TRACE switch in either the NORMal or REVerse position, the calibration voltage may be used for signal input suppression of either polarity and either range by dialing the desired value with the CAL/SUP control.

Sensitivity ..... Front panel, multiturn screwdriver-adjustable control, in combination with internal jumper pins, allows sensitivity control range to be set from 1 through 100 mV/div. Settings are: 1-4.5 mV/div; 4-14 mV/div; 13-39 mV/div; 36-100 mV/div.

Position ..... Front panel, multiturn screwdriver-adjustable control positions trace at any point across the record width.

Trace ..... Front panel, 4-position rotary switch with knob. OFF position removes signal and eliminates trace by placing it off scale. ZERO position shorts input for establishing calibration without external signal influence. NORMal position produces right-to-left trace deflection (facing the 1858) with positive signal on the positive (non-inverting) input terminal. REVerse position reverses trace deflection.

Specifications

Gage Excitation and Balance:

Voltage ..... 2.5, 5.0, or 10.0V dc ±0.25%

Current ..... 45 mA limited to not more than 75 mA. A continuous short will not cause permanent damage or affect other channels.

Ripple ..... <2 mV pk-pk, dc-25 kHz, measured during 15 μsec horizontal scan period of 1858 system.

Load Regulation ..... < ±0.1% of selected voltage, no load to full load.

Line Regulation ..... < ±0.1% of selected voltage for ±10% line input variation to 1858 system.

Temperature Coefficient ..... < ±0.025% of selected voltage, per degree C.

Sensing ..... Local or remote, selectable by internal jumper pins. Remote sensing leads appear at input connector of odd numbered channel.

Sense Lead Error ..... < ±0.5% of set voltage/16Ω sense lead resistance.

Balance Method ..... Shunt balance

Balance Range ..... Will balance >0.5Ω unbalance of a 120Ω gage; >4.0Ω unbalance of a 350Ω gage.

Bridge Completion ..... Completion resistors for other than 4-arm bridges must be made external to the 1858 system and can be arranged for 3-wire, one-arm configuration.

Calibration and Suppression:

Range ..... 1-10.00 mV and 10-100.0 mV. Range and polarity selected by front panel toggle switches. Front panel dial indicates set voltage.

Accuracy ..... Within ±0.1% at full scale setting at 25°C (77°F).

Linearity ..... Within ±0.5% of full scale

Drift ..... <±0.025% of setting per degree C.

Amplifier Input:

Type ..... Differential. By proper input, connections can be used with millivolt signal sources other than strain gages.

Impedance ..... >1 MΩ shunted by <100 pF

Source Resistance ..... All specifications apply for 0-1 kΩ, with 0-1 kΩ unbalance, except as separately stated.

Offset Current ..... 100 nA

Max Safe Input Voltage..... ±10V dc or peak ac

Max Operating Input Voltage ..... ±0.4V

Max Safe Common Mode Voltage..... ±10V dc or peak ac

Common Mode Voltage, Operating..... 0 to +5V dc or ac peak with suppression; −2 to +5V dc or ac peak without suppression.

Linearity ..... Within ±0.5% of full scale relative to gridlines.

Stability ..... Within ±0.025%, per degree C, relative to gridlines.

Sensitivity:

Range ..... 1 to 100 mV/div, continuously adjustable.

Accuracy ..... Adjustable to better than ±0.5% full scale relative to gridlines (SENS control).

Frequency Response:

dc to 1 kHz..... +0%, −3% max error

dc to 2 kHz..... +0%, −8% max error

dc to 3 kHz..... +0%, −18% max error

dc to 5 kHz..... +0%, −35% max error

Drift ..... <0.007 inch (0.175 mm) trace displacement per degree C, relative to gridlines at max gain. Typically <0.005 inch/°C (0.125 mm/°C).

Noise ..... <0.02 inch (0.5 mm) pk-pk, plus static trace width, at max sensitivity setting.

Common Mode Rejection (dc-60 Hz)..... >60 dB at any amplifier gain setting, with 350Ω source unbalance.

Crosstalk ..... Negligible

Overload Recovery ..... <10 msec to within 0.030 inch (0.75 mm) of final value for 10 times input overload to a max of ±10V peak.

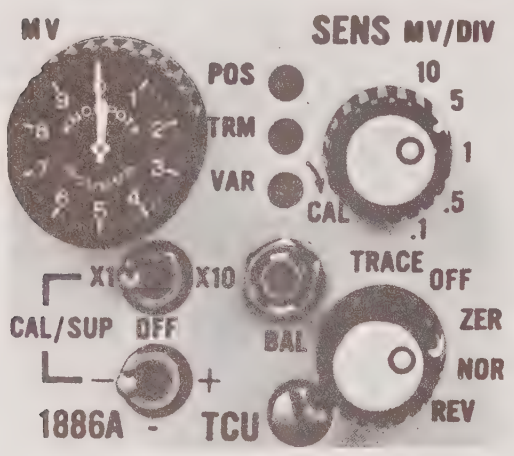
Filtering ..... Internal terminals for user-installed components for one 6 dB/octave low pass filter.

Output ..... TTL logic level pulses with pulse duration proportional to input-signal level for interfacing with 1858 system. No external outputs are provided.

Power ..... Draws all required power from 1858 system.

Environmental ..... Same as 1858 system.

1886A–TCU Thermocouple Control and Microvolt Amplifier Module



Description

The 1886A-TCU provides a convenient means of making accurate thermocouple-type temperature measurements, or other measurements where the signal levels are in the microvolt region. In addition to its sensitivity range of from 100 μV to 50 mV/div (1 inch, 25 mm), the 1886A-TCU provides dial-in input calibration and suppression of 1 to 100 mV. By using this calibration and suppression capability, the nonlinearities of thermocouples can frequently be disregarded. Accessory thermocouple compensation units are available for the most commonly used thermocouple types. The 1886A-TCU occupies two paired module spaces (for example, channels 1 and 2) in the 1858 system.

Front Panel Controls

Sensitivity ..... Front panel 5-position rotary switch, with knob, to set the system sensitivity in calibrated steps.

Variable Sensitivity ..... Multiturn screwdriver-adjustable control to vary the amplifier sensitivity between calibrated steps. At min setting, extends min sensitivity to 50 mV/div.

Position ..... Multiturn screwdriver-adjustable control positions trace at any point across the record width.

Trim ..... Multiturn screwdriver-adjustable control permits precise setting of system sensitivity.

Trace ..... 4-position rotary switch, with knob. OFF position removes signal and eliminates trace by placing it off scale. ZERO position removes the signal input and shorts the amplifier input for positioning trace and calibrating without signal influence. NORMal position produces right-to-left trace deflection (facing the 1858) with positive signal on positive (non-inverting) input terminal. REVerse position reverses trace deflection.

Calibration/Suppression ..... 10-turn control with high-torque, counting dial calibrated from 0 to 10.00 mV applies a precise calibration voltage to the amplifier input for adjustment of system sensitivity when the TRACE switch is in the ZERO position. Toggle switch extends range to 100.0 mV. Separate 3-position toggle switch selects + or — polarity or off. With the TRACE switch in either NORMal or REVerse position, the calibration voltage may be used for input suppression of either polarity and either input range by dialing the desired value with the CAL/SUP control.

Balance ..... Multiturn screwdriver-adjustable control allows the amplifier output to be zeroed (with no input signal)

Specifications

Input:

- Type ..... Differential
- Impedance ..... >1 MΩ shunted by <100 pF

Source Resistance ..... Sensitivity of 0.1 mV/div, 100Ω max; sensitivity of 0.5 mV/div, 500Ω max; sensitivity of 1-50 mV/div, 1 kΩ max.

- Offset Current ..... <20 nA
- Max Safe Input Voltage..... ±20V dc or peak ac
- Max Safe Common Mode Voltage..... ±20V dc or peak ac
- Max Operating Common Mode Voltage.... ±5V dc or peak ac

Sensitivity:

- Steps ..... 0.1, 0.5, 1, 5, 10 mV/div
- Accuracy ..... Adjustable to within ±0.5% full scale, relative to gridlines (trim control). Ratio accuracy between steps within ±0.5% full scale.
- Linearity ..... Within ±0.5% full scale, relative to gridlines.
- Stability ..... Within ±0.5% full scale per degree C, relative to gridlines.

Frequency Response:

Sensitivity	−5%	−10%	−3 dB
0.1 mV/div	5 Hz	7.5 Hz	15 Hz
0.5 mV/div	160 Hz	250 Hz	500 Hz
1-50 mV/div	1600 Hz	2500 Hz	5000 Hz

Drift:
(on record per degree C)

Sensitivity	Max	Typical
0.1 mV/div	0.042 div	0.018 div
0.5 mV/div	0.010 div	0.006 div
1 mV/div	0.006 div	0.005 div
5-50 mV/div	0.003 div	0.003 div

Noise (wideband) ..... 0.1 to 0.5 mV/div: <0.025 inch (0.625 mm) pk-pk on record, plus static trace width; 1 to 50 mV/div: <0.015 inch (0.375 mm) pk-pk, plus static trace width.

Common Mode Rejection (dc-60 Hz)..... 0.1 mV/div: >100 dB (typically >105 dB); 0.5 to 50 mV/div: >90 dB (typically >100 dB).

Crosstalk ..... DC to 100 Hz: <0.010 inch (0.25 mm) pk-pk on record, plus static trace width, at max sensitivity; dc to 5 kHz, <0.030 inch (0.75 mm) pk-pk, plus static trace width, at max sensitivity.

Overload Recovery ..... Sensitivity of 0.1 and 0.5 mV/div: <200 msec to within 0.030 inch (0.75 mm) of final value for 10 times overload to a max of ±20V peak; sensitivity of 1 to 50 mV/div: <1 msec.

Filtering ..... Internal terminals for user-installed components for one 6 dB/octave low-pass filter.

Output ..... TTL logic level pulses with pulse duration proportional to input signal level for interfacing with 1858 system. No external outputs are provided.

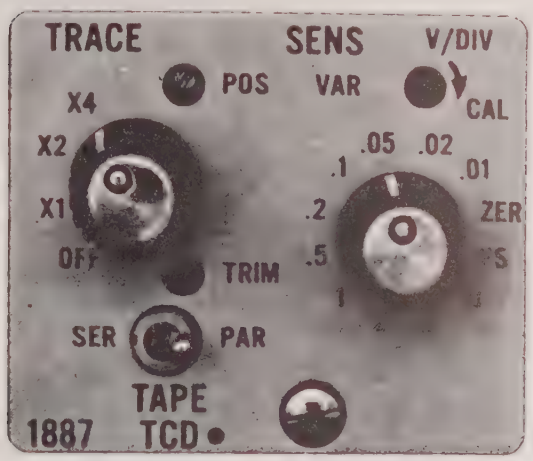
Calibration and Suppression:

- Range ..... 1.0 to 10.00 and 10.0 to 100.0 mV. Range and polarity selected by front panel toggle switches. Front panel dial indicates set voltage.
- Accuracy ..... Within ±0.1% at full scale setting at 25°C (77°F).
- Linearity ..... Within ±0.5% of full scale.
- Drift ..... <±0.25% of setting per degree C.

Power ..... Draws all required power from 1858 system.

Environmental ..... Same as 1858 system.

Model 1887A–TCD Tape Compatible Differential Amplifier Module



Description

The 1887A-TCD is a high-sensitivity, wide gain-range, differential amplifier which conveniently and simultaneously provides input signal conditioning for the Model 1858 Visicorder oscillograph and instrumentation-type magnetic tape recorders. A front panel switch allows selection of either parallel recording on the 1858 and the tape recorder, or serial playback recording from the tape recorder to the Model 1858. Changing from serial to parallel, or vice versa, does not necessitate changing connections or sensitivity settings. In the serial recording mode, recordings beyond the 5 kHz frequency range capability of the Model 1858 can be recorded on the tape at high speed and then played back at a lower speed into the Model 1858, yielding time scale expansion. Similarly, long term, slow speed tape recordings can be played back at high speed in a few seconds, yielding time scale compression and displaying long periods on a relatively short record.

The serial arrangement may also be used "on-line" wherein the Model 1858, in addition to serving as a "quick-look" monitor and providing a permanent record, verifies that the data is recorded on the tape. Front panel switch selection allows ±1, 2 or 4 division trace amplitude for full scale (±1.414V) tape record or playback. System sensitivity is from ±10 mV to ±25V/div (1 inch, 25 mm) and for ±1.414V (1V rms) output to the tape recorder. A full-scale RTI calibration voltage allows setting of trace amplitude and/or FM tape recorder deviation. The 1887A-TCD occupies two paired module spaces of the 1858 system (for example, channels 1 and 2). Interconnection with the tape recorder is made via the odd-numbered MS type connector on the rear of the Model 1858. Terminal C is output to the tape recorder, terminal A is input from the tape recorder, terminal E is common.

If the module input is connected to a source that can deliver more than 1A, U.L. requirements state that a fuse with less than 1A rating and with sufficient current interruption capability be placed in series with the signal input leads.

Front Panel Controls

Sensitivity ..... 12-position rotary switch, with knob, to set system sensitivity in 10 calibrated steps, plus zero and full-scale calibration. ZERo position removes signal and shorts amplifier input to allow setting of trace position. The FS position removes signal input and substitutes a fixed dc level equivalent to full scale at the amplifier input to allow adjusting trace amplitude and FM tape recorder deviation.

Variable Sensitivity ..... Multiturn screwdriver-adjustable control to vary the amplifier sensitivity between calibrated steps and extend range to ±25V/div and ±1.414V tape output.

Position ..... Multiturn screwdriver-adjustable control to position trace at any point across the record width. Does not affect output to tape recorder.

Trim ..... Multiturn screwdriver-adjustable control permits precise setting of trace sensitivity.

Trace ..... Four-position rotary switch selects ±1, 2 or 4 div trace deflection for ±1.414V tape record or playback. OFF position eliminates trace by placing it off-scale. Trace switch does not affect output to tape recorder.

Serial-Parallel ..... Two-position toggle switch. SERial position applies conditioned signal to input of tape recorder only with 1858 trace deflection signal from output of tape recorder. PARallel position simultaneously applies conditioned signal to 1858 trace and input to tape recorder and opens circuit from output of tape recorder.

Internal Controls

Tape Trim ..... Multiturn screwdriver-adjustable control permits precise adjustment of output to tape recorder.

Normal-Reverse ..... Jumper pins allow reversal of trace deflection. Normal position (+) produces right-to-left trace deflection (facing the 1858) with positive signal on the noninverting input terminal. Reverse position (−) reverses trace deflection. Does not affect output to tape recorder.

Balance ..... Two multiturn, screwdriver-adjustable controls allow the amplifier dc output to be zeroed (with no input signal).

CM Adjustment ..... Two multiturn, screwdriver-adjustable controls allow common mode rejection ratios to be optimized for 0.01 to 0.5V/div and 1 to 10V/div sensitivity ranges.

Specifications

Input Signal

Type	Differential
Impedance:	
Differential	2 ±0.1 MΩ shunted by <80 pF
Single-Ended	1 ±0.05 MΩ shunted by <160 pF
Max Safe Input Voltage:	
Sensitivity 0.01-0.5V/div	±100V dc or peak ac
Sensitivity 1.0-10V/div, FS, Zero	±300V dc or peak ac
Max Operating Input Voltage	±6X input sensitivity setting (±6 div)
Max Safe Common Mode Voltage:	
Sensitivity 0.01-0.5V/div	±100V dc or peak ac
Sensitivity 1.0-10V/div, FS, Zero	±300V dc or peak ac
Max Operating Common Mode Voltage:	
Sensitivity 0.01-0.5V/div	±5V dc or peak ac
Sensitivity 1.0-10V/div, FS, Zero	±300V dc or peak ac
Common Mode Resistance to Ground	0.5 ±0.025 MΩ
Source Resistance	All specifications apply for 0-1 kΩ, with 1 kΩ unbalance, except as separately specified.
Offset Current	50 nA max
Sensitivity:	
Steps	10 steps; ±0.01, 0.02, 0.05, 0.1, 0.2, 0.5, 1.0, 2.0, 5.0, 10.0V/div and V/±1.414V output to tape.
Accuracy	Adjustable to better than ±0.5% full-scale, relative to gridlines (trim control). Total of ratio accuracy between steps and gain stability over full environmental range is within ±1%.
DC Linearity	Within ±0.5% full scale (6 div) relative to gridlines.
Frequency Response (Signal Input to 1858 Trace):	
dc to 1 kHz	+0%, −0.5% max error
dc to 2 kHz	+0%, −1.3% max error
dc to 3 kHz	+0%, −3% max error
dc to 5 kHz	+0%, −10% max error
Frequency Response (Signal Input to Tape Output):	
dc to 50 kHz	+0.5 dB, −1.0 dB
dc to 80 kHz	+1.0 dB, −1.5 dB
dc to 100 kHz	+1.5 dB, −3.0 dB
Drift	<±0.003 div/°C relative to gridlines on record at any sensitivity setting, with trace switch at X1.

(continued on next page)

Noise (wideband) ..... <0.015 div pk-pk, plus static trace width switch, on record at any sensitivity setting, with trace switch at X1

Common Mode Rejection (dc-60 Hz):

Sensitivity V/Div.	1 kΩ Source Unbalance (Minimum)	No Source Unbalance (Minimum)	No Source Unbalance (Typical)
0 01	50 dB	60 dB	90 dB
0 02	50 dB	60 dB	88 dB
0 05	50 dB	60 dB	86 dB
0 1	50 dB	60 dB	82 dB
0 2	50 dB	60 dB	76 dB
0 5	50 dB	60 dB	70 dB
1.0-10.0	50 dB	60 dB	64 dB

Crosstalk ..... <0.035 div pk-pk, plus static trace width, on record at any sensitivity setting, with trace switch at X1.

Overload Recovery ..... <100 μsec to within ±1% of final value for 10 times sensitivity setting, to a max of 100V peak

Filtering ..... Internal terminals for user-installed components for 12 dB/octave low pass filter. Does not affect output to tape recorder

Input (From Tape Recorder)

Type ..... Single-ended to ground

Input Impedance ..... 20 ±2 kΩ

Source Resistance ..... Limited only by source loading considerations

Max Safe Input Voltage..... ±10V dc or peak ac

Max Operating Input Voltage ..... ±9V dc or peak ac

Sensitivity ..... ±1.414V (1V rms) produces ±1, ±1%, division trace movement on the Model 1858 with trace switch in X1 position.

Frequency Response:

dc to 1 kHz..... +0%, −0.5% max error

dc to 1 kHz..... +0%, −1.3% max error

dc to 3 kHz..... +0%, −3% max error

dc to 5 kHz..... +0%, −8% max error

DC Offset ..... ±0.015 div max, with trace switch at X1.

Output (To Tape Recorder)

Impedance ..... <2Ω

Voltage ..... ±1.414V, ±1% for 1X sensitivity dial setting, to a max of 6X, into ≥10 kΩ.

Noise:

Wideband ..... <50 mV pk-pk

To 10 kHz ..... <15 mV pk-pk (typical)

Spikes ..... <200 mV pk-pk at approximately 3 MHz, decaying in approximately 5 cycles at 50 kHz rate

Drift ..... <±4 mV/°C RTO (equivalent to 0.003 div/°C on 1858 trace with trace switch at X1)

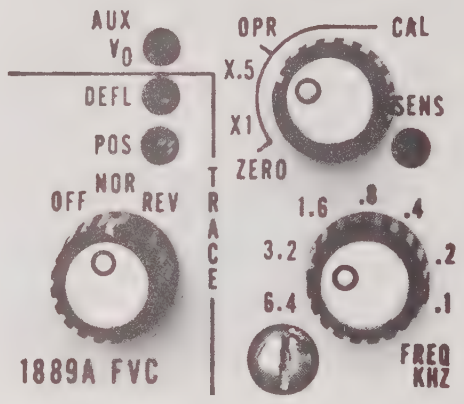
General

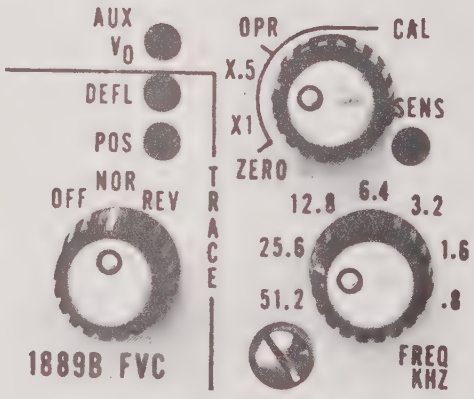
Power ..... Draws all required power from 1858 system.

Environmental ..... Same as 1858 system.

Mean Time Between Failures (MTBF)..... >17,000 hr

Model 1889A-FVC/1889B-FVC Frequency-to-Voltage Converter Modules





Description

The Models 1889A-FVC and 1889B-FVC provide a dc output directly proportional to the frequency, but independent of the amplitude, of an ac or pulsed dc input signal. Designed primarily for use with magnetic pulse type speed or flow transducers, the 1889 modules may be used as well to measure and record frequency or frequency deviation from other signal sources in a variety of applications

In addition to producing analog recordings on the Model 1858 Visicorder oscillograph, an auxiliary output is provided for magnetic tape recording or for other recording, display, alarm or control purposes. The modules also feature a precision crystal oscillator having selectable frequencies for convenience and accuracy in set-up and calibration. Full scale frequency input can produce up to full width recording on the Model 1858 and up to +5.0V at the auxiliary output.

The Model 1889A-FVC has seven ranges to a maximum of 6.4 kHz input frequency. The 1889B-FVC also has seven ranges but to a maximum of 51.2 kHz. Both have selection of "fast" or "slow" response time.

The modules occupy two paired module spaces of the Model 1858. Signal input is to the even-numbered connector on the rear of the Model 1858; the auxiliary output is from the odd-numbered connector.

Front Panel Controls

Frequency ..... Seven-position rotary switch, with knob, selects full scale input frequency range.
1889A-FVC: 0.1, 0.2, 0.4, 0.8, 1.6, 3.2, 6.4 kHz.
1889B-FVC: 0.8, 1.6, 3.2, 6.4, 12.8, 25.6, 51.2 kHz.

Sensitivity ..... Multiturn screwdriver control sets threshold voltage level at which unit will respond to an input signal.

Calibrate/Operate ..... Four-position rotary switch with knob.

ZERO position ..... Removes input signal influence for trace base positioning and for zeroing devices connected to auxiliary output.

CAL X1 position ..... Removes input signal influence and substitutes a precision calibration frequency equal to the full scale frequency selected by the FREQ control.

CAL X.5 position ..... Removes signal influence and substitutes a precision calibration frequency equal to one-half the full scale frequency selected by the FREQ control.

OPERATE position ..... Removes calibration signal and connects the signal input for operation.

Trace ..... Three-position rotary switch with knob.

OFF position ..... Removes signal input and eliminates trace on Model 1858 by placing it off scale Does not affect auxiliary output.

NORMAL position ..... Produces right-to-left trace deflection (facing the 1858) with increasing input frequency. Does not affect auxiliary output.

REVERSE position ..... Reverses direction of trace deflection. Does not affect auxiliary output.

Trace Position ..... Multiturn screwdriver adjustable control positions trace of Model 1858 at any point across the record width. Does not affect auxiliary output.

Trace Deflection ..... Multiturn screwdriver adjustable control allows trace deflection of the Model 1858 to be adjusted between 10 and 100% of record width for full scale signal input frequency between 0.5 and 1.0 times that selected by FREQ control. Does not affect auxiliary output.

Aux. V_O ..... Multiturn screwdriver adjustable control permits auxiliary output to be adjusted between +0.5 and +5.0V (into 10 kΩ) for full scale signal input frequency between 0.5 and 1.0 times that selected by the FREQ control. Does not affect trace on 1858.

Internal Controls

Response ..... Jumper pin to select time constant of filter. "Slow" response minimizes ripple (see Table 1).

AC/DC Coupling ..... Two jumper pins allow selection of either ac or dc input coupling.

Specifications

All specifications apply over the specified environmental range except as otherwise stated.

Input:

Type ..... Differential

Impedance:

Normal Mode ..... >100 kΩ

Common Mode ..... >55 kΩ

Sensitivity ..... +0.1 to +200V pulsed dc or ac peak. Counts on positive-going signals, referenced to 0V.

Max Safe Input Voltage ..... ±200V dc or ac peak

Max Safe Common Mode Voltage ..... ±20V dc or ac peak

Max Operating Common Mode Voltage ..... ±5V dc or ac peak (at 60 Hz)

Max Source Impedance ..... 1 kΩ with up to 1 kΩ unbalance

Allowable Input Wave Shapes ..... Sine, square, triangular, pulse. Counts on positive-going signals, referenced to 0V. If input signal does not return to or go through zero, internal jumper pins must be set for ac coupling. Minimum pulse width is 20 μsec (1889A-FVC); 10 μsec (1889B-FVC).

Common Mode Rejection ..... 60 dB at 60 Hz with 1 kΩ max source impedance with no source unbalance, 50 dB with 350Ω source unbalance. (For reference only for the purpose of determining max operating CMV at frequencies other than 60 Hz. CMR decreases with increasing frequency at approximately 6 dB/octave.)

Response Time and Ripple (Typical) — Table 1:

1889A-FVC

Fast Response

F.S. Freq. (kHz)	Response Time (Sec) to % Final Value 63%	99%	Pk-Pk Ripple (% Set F.S. Value), F.S. Freq. Ratio of: 0.1	1.0
0.1	0.2	1.0	0.5	0.5
0.2	0.1	0.5	0.5	0.5
0.4	0.05	0.25	0.5	0.4
0.8	0.025	0.125	0.5	0.3
1.6	0.013	0.065	0.5	0.2
3.2	0.007	0.035	0.5	0.15
6.4	0.003	0.015	0.3	0.1

Slow Response

F.S. Freq. (kHz)	Response Time (Sec) to % Final Value 63%	99%	Pk-Pk Ripple (% Set F.S. Value), F.S. Freq. Ratio of: 0.1	1.0
0.1	1.0	5.0	0.25	0.25
0.2	0.5	2.5	0.25	0.25
0.4	0.25	1.25	0.25	0.25
0.8	0.14	0.7	0.25	0.2
1.6	0.07	0.35	0.25	0.1
3.2	0.03	0.15	0.25	0.1
6.4	0.015	0.075	0.2	0.1

1889B-FVC

Fast Response

F.S. Freq. (kHz)	Response Time (Sec) to % Final Value 63%	99%	Pk-Pk Ripple (% Set F.S. Value), F.S. Freq. Ratio of: 0.1	1.0
0.8	0.033	0.165	0.35	0.35
1.6	0.017	0.085	0.35	0.35
3.2	0.008	0.04	0.35	0.3
6.4	0.004	0.02	0.35	0.25
12.8	0.002	0.01	0.35	0.2
25.6	0.001	0.005	0.35	0.15
51.2	0.0005	0.0025	0.25	0.15

Slow Response

F.S. Freq. (kHz)	Response Time (Sec) to % Final Value 63%	99%	Pk-Pk Ripple (% Set F.S. Value), F.S. Freq. Ratio of: 0.1	1.0
0.8	0.15	0.75	0.1	0.1
1.6	0.075	0.375	0.1	0.1
3.2	0.04	0.2	0.1	0.1
6.4	0.02	0.1	0.1	0.1
12.8	0.01	0.05	0.1	0.1
25.6	0.005	0.025	0.1	0.1
51.2	0.003	0.015	0.1	0.15

Accuracy ..... Output levels may be adjusted via the trace deflection and auxiliary V_O controls to be proportional to full scale input frequency within <0.5%.

Temperature Coefficient of Full Scale Accuracy (Average):

1858 Trace ..... <0.06%/°C

Auxiliary Output ..... <0.02%/°C

Linearity (max deviation from a straight line passing between 0 and full scale):

1858 Trace ..... ±0.35% F.S.

Auxiliary Output ..... ±0.1% F.S.

Temperature Coefficient of Zero Drift, % F.S./°C (Average)

1889A-FVC

Selected Range (kHz)	0.1	0.2	0.4	0.8	1.6	3.2	6.4
1858 Trace (%)	0.07	0.05	0.035	0.03	0.025	0.021	0.021
Aux. Output (%)	0.05	0.025	0.014	0.006	0.004	0.002	0.001

1889B-FVC

Selected Range (kHz)	0.8	1.6	3.2	6.4	12.8	25.6	51.2
1858 Trace (%)	0.08	0.05	0.035	0.03	0.025	0.22	0.021
Aux. Output (at ≤50% RH) (%)	0.06	0.03	0.015	0.01	0.005	0.002	0.001

Calibration:
Method ..... Crystal oscillator frequency substitution

Frequencies:
1889A-FVC

Selected Range (kHz)	0.1	0.2	0.4	0.8	1.6	3.2	6.4
Cal X.5 (kHz)	0 05	0 1	0 2	0 4	0.8	1 6	3.2
Cal X1 (kHz)	0 1	0 2	0 4	0 8	1 6	3 2	6.4

1889B-FVC

Selected Range (kHz)	0.8	1.6	3.2	6.4	12.8	25.6	51.2
Cal X.5 (kHz)	0.4	0.8	1.6	3.2	6.4	12.8	25 6
Cal X1 (kHz)	0.8	1.6	3.2	6.4	12.8	25.6	51.2

Accuracy ..... Within ±0.01% of selected frequency

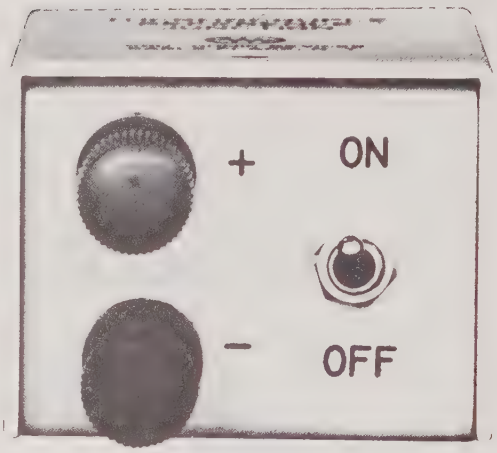
Auxiliary Output:
Configuration ..... Single ended to ground
Voltage ..... Adjustable from +0.5 to +5.0V F.S. into 10 kΩ.
Impedance ..... <12 kΩ
Loading ..... 10 kΩ min
Protection ..... A short will not cause permanent damage or affect the trace of the Model 1858.

Environmental:
Temperature:
Operating ..... 0 to 50°C (32 to 122°F)
Nonoperating ..... −62 to 71°C (−80 to 160°F)
Humidity:
Operating ..... 5 to 95% relative, noncondensing
Nonoperating ..... 5 to 95% relative, noncondensing
Altitude:
Operating ..... to 15,000 ft (4.5 km)
Nonoperating ..... to 50,000 ft (15.2 km)

General

Power ..... <2W (obtains required operating power from mainframe)
Dimensions ..... 2 inch (5.1 cm) H x 2 inch (5.1 cm) W x 9¼ inch (23.5 cm) D
Weight ..... <16 oz (0.45 kg)
MTBF ..... 15,100 hr

Thermocouple Reference Junctions



Description

Accessory thermocouple-reference junctions provide a convenient means for making temperature measurements with the 1858 system. While typically used in combination with the 1886(A)-TCU signal-conditioning module, the thermocouple reference unit may also be used with the 1885(A)-SGC where the thermocouple output is in the millivolt range and common mode voltages are negligible.

The thermocouple reference unit provides the equivalent of a 32°F (0°C) ice-bath, cold junction through a battery-powered, resistance-bridge, temperature-compensation network.

The small size of the unit with its self-contained mercury-cell battery allows it to be placed, and conversion to copper cables made, near the point of measurement. This greatly reduces the cost and inconvenience of installing thermocouple-extension cables, particularly when long distances are involved.

Accessory 3 ft (0.9 m) cables with connectors are available for connecting reference junctions to the 1858 in applications where the 1858 system is near the point of temperature measurement.

Reference junctions are available for E, J, K, R, S and T-type thermocouples.

Specifications

Size ..... 1.75 inch (45 mm) high x 2 inch (51 mm) wide x 4 inch (102 mm) deep.
Battery Type ..... Mallory 601R or equivalent (replaceable)
Battery Life ..... 2500 hr use, or 2 yr shelf life (typical).
Input Connection ..... Binding Posts (2)
Output Connection ..... GR type banana plug

Compensation Accuracy in °C (Ref. 0°C)

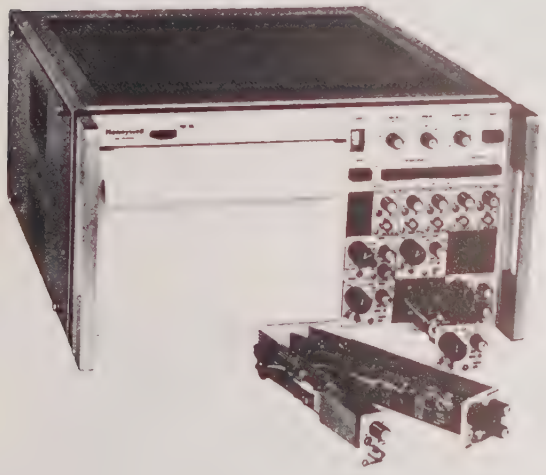
Type	Ambient Temperature Range, °C	
	0 to +50	+20 to +30
E	±0.8	±0.25
J	±0.8	±0.25
K	±0.8	±0 25
R	—	±1.0
S	—	±1.0
T	±0.8	±0.25

Ordering Information

The ordering code system below has been developed for ordering convenience and accuracy. Proper and complete coding will assure filling your order correctly and promptly. As a suffix to the basic Model 1858, indicate your selections by the proper order code numbers and letters in the same order as the columns. If an option is not required, insert a letter "O" in the appropriate location.

Selection of Features to be installed	Basic System	Take-up	Timing	Trace Ident.	Housing Interface	UL Listing
Basic Model No. 120/240V 50-400 Hz	1858					
With Internal Takeup		T				
Five Interval Timing System			7			
Numbered Trace Identification				9		
Added Channel Housing					H	
UL 1244 (IND)						G
UL 544 (MED)						M

Signal Conditioning



1881-HGD* ..... High-gain differential amplifier module

1882-LGD* ..... Low-gain differential amplifier module

1883A-MPD* ..... Medium-gain differential amplifier module

1884-IFM* ..... Interface module

1885A-SGC* ..... Strain gage control module

1886A-TCU* ..... Thermocouple control and microvolt amplifier module

1887A-TCD* ..... Tape compatible differential amplifier module

1889A/B-FVC* ..... Frequency-to-voltage convertor module

16776257-001† ..... Blank panel, single module width

Thermocouple Compensation Units

Type K (chromel/alumel)† ..... P/N 16778605-001

Type T (copper/constantan)† ..... P/N 16778605-002

Type E (chromel/constantan)† ..... P/N 16778605-003

Type J (iron/constantan)† ..... P/N 16778605-004

Type S (10% rhodium/platinum)† ..... P/N 16778605-005

Type R (13% rhodium/platinum)† ..... P/N 16778605-006

Cable 3 ft comp. unit to 1858† ..... P/N 16778292-001

Accessories

Latensifier, Model 58L* ..... P/N 16775753-004
usable on 120/240V, 50-60 Hz models only.

Latensifier** ..... P/N 16792616-002
switch selectable 50-60/400 Hz, usable on both 120 and 240V models.

Writing Platen† ..... P/N 16778736-003

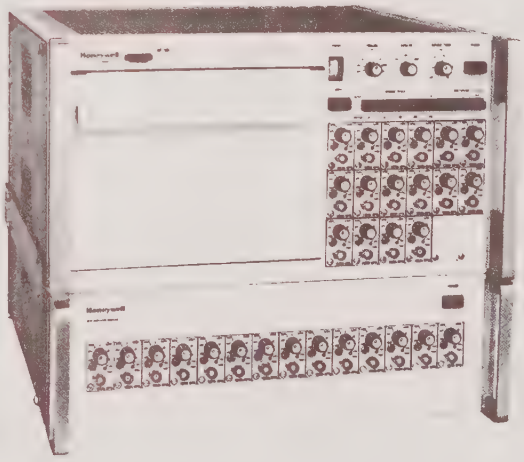
14 Channel Add-on Housing** ..... Model 1870

Rack Mounting Kit (1870)† ..... P/N 16779678-001

Rack Mounting Kit (1858)† ..... P/N 16776101-002

Padded Transit Case† ..... P/N 16788279-002
(for 1858 only)

Padded Transit Case† ..... P/N 16788669-001
(1858 and 1870)



*U.L. accepted.
**Not submitted for U.L. listing.
†U.L. not applicable.

For 1871 Amplifier Housing information, see D-2488.

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Honeywell

Oscillographic Recorders

APPLICATION INFORMATION

Contains application data and suggested input connections to get maximum use from your Model 1858 Visicorder oscillograph

General

The Honeywell Model 1858 Visicorder oscillograph system, first introduced in May of 1972, has become widely accepted as the most compact and convenient graphic data acquisition system available. This acceptance has resulted in its use, not only by those skilled in electronic instrumentation technology, but also by those involved in other engineering and testing fields. In many such situations, the engineer or technician may not have experience in the electrical and electronic aspects of instrumentation. He may have to spend time experimenting, and perhaps consulting with others, before he can properly set up his recording system for a specific test.

The Model 1858 system was designed for maximum user convenience — to make the system usable by those who may not be experienced in instrumentation techniques as well as by the more experienced users. The capability of readily adapting the system to a variety of applications was another important factor in its design. While the application data that follows is intended for the user with limited experience in instrumentation techniques, the circuit arrangements, shown for a variety of input signal source conditions, should also be convenient for the experienced instrumentation user.

The input circuit arrangements shown should cover 80 to 90 percent of those situations the user will encounter in his measurement problems. However, under certain circumstances of excessive electrical noise interference, the suggested arrangements may have to be altered somewhat for best results. For example, strong radiated energy in the radio frequency spectrum from a nearby radio or television station or radar equipment may not be effectively shielded out by using the recommended data signal shielding techniques shown and supplementary "RF" shielding may be required. Or, when making low level measurements near large motors, generators or transformers, induced fields may be so strong that signal leads may have to be placed inside iron conduits isolating them from power or other "noisy" wiring.

Certain devices on which measurements must be made are, by their very nature, radio frequency noise generators. These devices are difficult to deal with and no amount of shielding will eliminate the resulting noise problems. An example of this is taking a voltage measurement across a switch contact that produces an electrical arc when the switch is opened or closed. Very high voltages over a frequency spectrum extending into the megahertz range, both normal mode and common mode, are created. In such cases, specially designed filters may be required in the signal input leads. These less-frequent problems are not dealt with in this publication. The circuit arrangements shown are intended to minimize degradation of the data signal caused by:

- ground loops
- electrostatic coupling
- electromagnetic coupling
- common mode voltages

A brief discussion of each of these terms, and their effect on the data signals, will aid in understanding the circuit arrangements shown.

Probably the most difficult and least understood applications problems are those of providing proper shielding to avoid electrostatic and electromagnetic "pickup" and also providing grounding to eliminate ground loops. One of the reasons for so many such difficulties is that the preferred practices don't always work the best because of other unidentified vagaries of the system. Other arrangements for shielding and grounding may be found to be better through experimentation.

Ground Loops

A voltage difference (usually 50, 60 or 400 Hz power frequency) typically exists between any two or more different ground locations even though they may be tied together by electrical conduits or heavy copper cables. Ground currents through such conductors have been measured in excess of 100 amperes in some industrial plants. If only one ampere was flowing through a ground path of 0.1 ohm, a voltage drop of 0.1 volt would be produced. If the shield and/or signal lead were grounded at each end of this path, this 0.1 volt would be applied as a signal in series with the normal signal path.

Signal and/or shield grounds should always be made at a single point, preferably at the signal source. Grounding at the amplifier end is acceptable when it is impossible or inconvenient to do so at the source, or if the ground at the source is "noisy". Grounded sources should not be connected to amplifier inputs that are not floating above ground (such as a tape recorder to a single ended-to-ground amplifier) unless the two grounds are known to be at the same potential. The importance of proper grounding cannot be overemphasized.

Electrostatic Coupling

Electrostatic coupling refers to the capacitive coupling between the signal leads and a "noise" voltage source. Twisting the signal leads tends to equalize each signal lead's capacitance to the voltage source. Therefore, each lead has an equal amount of noise and, in the case of a differential input, is canceled out at the amplifier input. If the leads are not twisted, unequal capacitances will exist between the input leads and the voltage source and the amplifier will see a noise signal as a normal mode signal which is the voltage difference between the two leads.

Signal input leads should be shielded. Shielding material, usually braided copper or aluminum wrapping, aids in reducing the effects of electrostatic fields. In some circumstances, double shielding may be necessary depending on how low the signal level and how strong the electrostatic interference field. In general, it is desirable to have the shield at the same potential as the signal by tying the shield to signal low. The shield should, of course, have an outer layer of insulation to prevent off-ground voltages from being shorted to ground and to avoid ground loop problems.

Electromagnetic Coupling

Electromagnetic coupling refers to the inductive coupling between the signal leads and ac electromagnetic fields that typically surround the input leads at some point along their length.

The input lead pair should be twisted. Twisting the signal leads reduces the loop area by which magnetic fields may couple circulating currents into the signal leads. While such fields may be quite low, the induced voltage on an untwisted input cable can be quite high, sometimes many times greater than the signal because of the high input impedance of the amplifier. The lower the signal level (the higher the required amplifier sensitivity), the greater is the importance of twisting.

In some cases, it is necessary to isolate the twisted and shielded input cables through an iron conduit to provide electromagnetic shielding. A typical situation could involve shielding thermocouple signal leads in an industrial plant where strong electromagnetic fields, caused by the large currents required by motors, welders, and similar machinery, are present.

Common Mode Voltage Considerations

To properly apply instrumentation where common mode voltages exist, it is important to understand what is meant by Normal Mode Voltage (NMV), Common Mode Voltage (CMV), Common Mode Rejection (CMR), and Common Mode Rejection Ratio (CMRR).

Normal Mode Voltage (NMV) is the applied signal voltage where the voltages applied to the input high and low are of opposite phase or different amplitude. Unwanted noise can show up as Normal Mode Voltages when care has not been taken in properly twisting and shielding the input signal leads. The best possible Common Mode Rejection specifications of an amplifier cannot correct this situation.

Common Mode Voltage (CMV) is that which may exist between the signal leads and ground, wherein the voltage applied to the input high and low are of the same phase and magnitude.

An excellent example of where common mode signals are encountered is in making current measurements from a 100 mV current shunt in the high side of a 120V ac power line, the low side of which is at ground potential. The amplifier input high and low would be connected across the shunt, thus the Normal Mode Voltage would be ±100 mV, whereas the Common Mode Voltage would be ±120V x 1.414 or ±170V peak.

Common Mode Rejection (CMR) is the ability of an amplifier to disregard a voltage applied simultaneously to both the input high and low terminals. This value is expressed in decibels.

The Common Mode Rejection capability of an amplifier is usually stated at 60 Hz, the most common frequency encountered. As the frequency of the Common Mode Voltage is increased, the Common Mode Rejection capability decreases, typically at a rate of 20 dB per decade change in frequency. Therefore, 80 dB (CMRR = 10,000:1) of CMR at 60 Hz may be approximately 60 dB of CMR (CMRR of 1,000:1) at 600 Hz.

Common Mode Rejection Ratio (CMRR) is another, and more usable, means of expressing CMR capability and is expressed as a direct ratio. A CMR of 80 dB has a CMRR of 10,000:1.

In the previous example, the ±170V peak Common Mode Voltage, with an amplifier having an 80 dB CMR capability, would result in a voltage of $\frac{170}{10{,}000} = \pm 0.017$V referred to the input. The amplifier would treat this input as a normal mode signal.

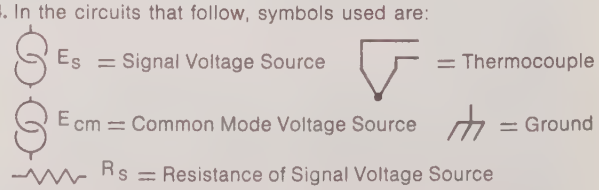
Using the 1881-HGD amplifier connected to a current shunt as in the example above, with 80 dB CMR at a sensitivity of 1V/div (inch), there could be ±0.017 (0.034 pk-pk) inches of 60 Hz "noise" or error signal on the trace. If operated at a sensitivity of 100 mV/div, there could be ±0.17 (0.34 pk-pk) inches of "noise" or error signal on the trace.

Grounding

In general, the signal leads and/or shields should be grounded at the signal source. This assumes that the ground is "quiet": that is, it is and remains at a potential of zero in reference to all other potentials in the system. The ground may or may not (i.e., vehicular) have an ohmic path to earth. If the ground near the signal source is known to be "noisy" due to alternating or aperiodic currents flowing through the ground path, it may be necessary to violate the preference for grounding at the source and ground at the instrument end of the system.

The following text and illustrations provide suggested signal input, shielding and grounding connections for the many possible signal sources used with the Model 1858 and its signal conditioning modules. The modules include: 1881-HGD, 1882-LGD, 1883A-MPD, 1884-IFM, 1885A-SGC, 1886A-TCU, 1887A-TCD and 1889A/B-FVC. While these suggested arrangements may not be the best in certain situations due to unanticipated noise sources, they are based on sound instrumentation practices and are, at least, a good starting point.

1. Proper operation of the Model 1858 Visicorder oscillograph requires that the unit be connected to ground. This is accomplished by a three-wire power cord with ground terminal. The Model 1858 must not be used on ungrounded ac power circuits or with a three wire to two wire "cheater" plug adapter unless the case is separately connected to a solid ground. On all rear panel signal input connectors, pin E is tied directly to the oscillograph case (ground). This provides proper signal ground if grounding practices as previously described are followed.
2. When using thermocouples, the positive (+) signal lead is the first metal in the thermocouple type; i.e., with an iron/constantan thermocouple, the iron lead produces a positive signal with respect to the constantan. This signal must be connected to the positive terminal of the Honeywell Thermocouple Compensation Unit P/N 16778605. **Note:** NBS and ANSI standards designate the red thermocouple lead as the negative potential.
3. Extreme care must be exercised when constructing attenuators to reduce high level signals to a lower value within the range of the amplifier input. Improper construction can result in attenuating only the Normal Mode Voltage from sources driven off ground, and can actually create a high Common Mode Voltage from grounded sources. Either of these may exceed the maximum CMV rating of the amplifier and result in severe damage to the instrument. Therefore, the design and construction of such attenuators should be attempted only by qualified personnel.
4. In the circuits that follow, symbols used are:



5. Modules with "A" suffix are identical to those without suffix for the purpose of these discussions.

Model 1881—HGD High Gain Differential Amplifier.

Model 1882—LGD Low Gain Differential Amplifier.

APPLICATION DATA

Description

The 1881-HGD is a high gain, floating and guarded dc amplifier, designed to accept low level input signals. System sensitivity is ±1 mV to ±1V per division (1 inch, 25 mm), with common mode voltage capability to ±300V peak. The amplifier occupies two paired module spaces (for example, channels 1 and 2) of the 1858 system.

Description

The 1882-LGD is a low gain, floating and guarded dc amplifier. It is designed to accept high level input signals, giving a system sensitivity of ±100 mV to ±200V/div (1 inch, 25 mm) to a maximum of ±300V, at common mode voltages to ±300V peak. The amplifier occupies two paired module spaces (for example, channels 1 and 2) of the 1858 system.

Type

Floating and guarded.

Primary Application

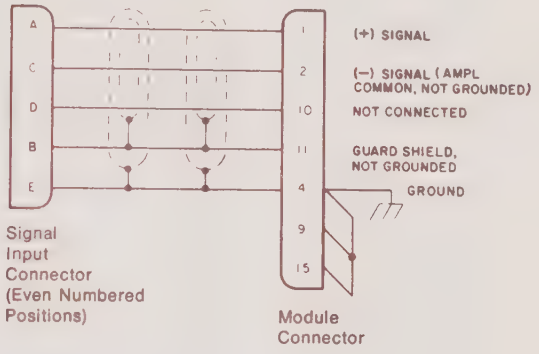
Conditions low through high level signals with Common Mode Voltages of up to ±300V.

Unique Characteristics

Isolator power supply and mod-demod circuit accommodates Common Mode Voltages to ±300V with high impedance signal to ground isolation.

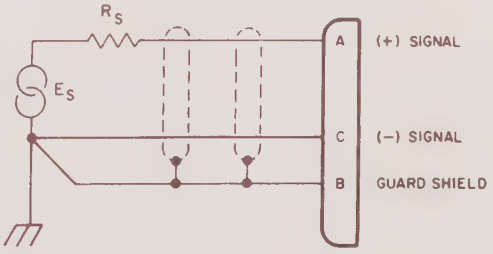
SIGNAL INPUT

Signal input to module connections, Model 1858.

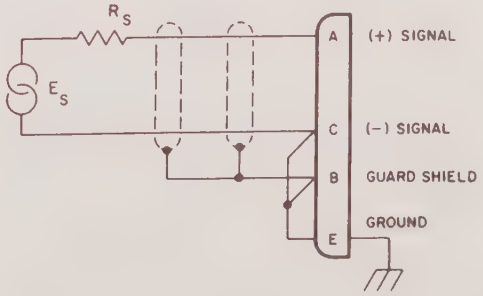


SUGGESTED CONNECTIONS

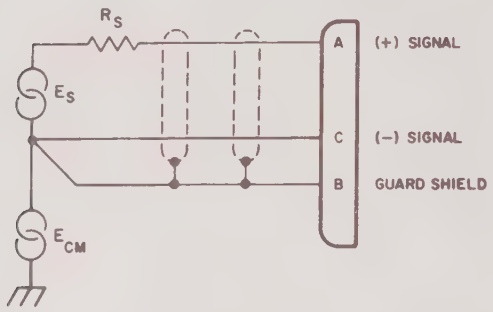
1. Source is single ended to ground (grounded at source).



2. Source is floating, not driven off-ground, not grounded but can be, cannot be grounded at source.

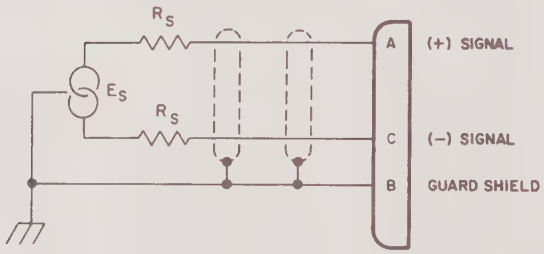


3. Source is floating and driven off-ground (Common Mode Voltages exist), cannot be tied to ground.

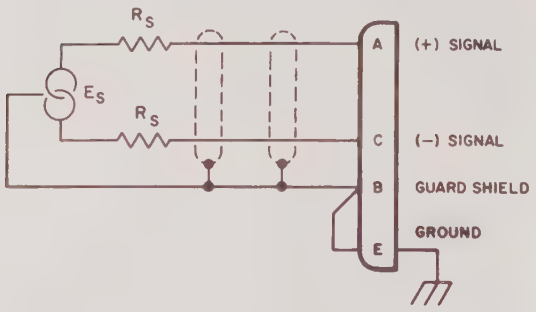


Note: Do not exceed maximum allowable Common Mode Voltage.

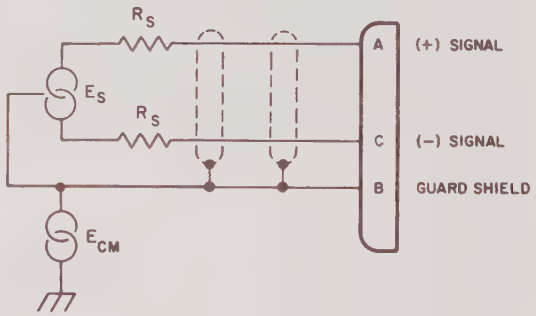
4. Source is balanced to ground, grounded at source.



5. Source is balanced and floating, not driven off-ground, not grounded but can be, cannot be grounded at source.



6. Source is balanced and floating, driven off-ground (Common Mode Voltages exist), cannot be tied to ground.



Note: Do not exceed maximum allowable Common Mode Voltage.

Model 1883A—MPD Medium Performance Differential Amplifier.

APPLICATION DATA

Description

The 1883A-MPD is a medium-gain, differential dc amplifier. It is designed to accept moderately low level input signals, giving a system sensitivity of ±50 mV to ±1V/div (1 inch, 25 mm) at common mode voltages to ±15V peak. Internal jumper pins allow for disabling the rear input in favor of a front panel BNC input connector. The amplifier occupies a single module space in the 1858 system.

Type

Differential.

Primary Application

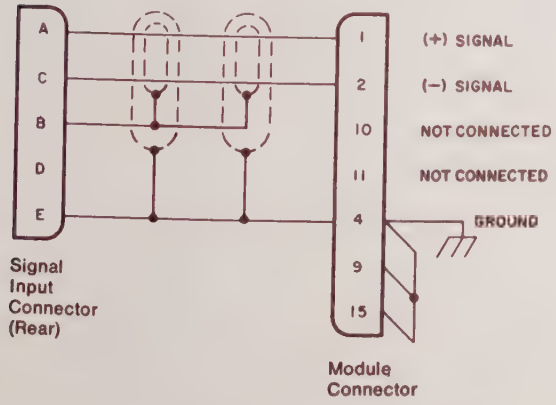
Conditions moderately low signal levels with Common Mode Voltages not greater than ±15V dc or peak ac.

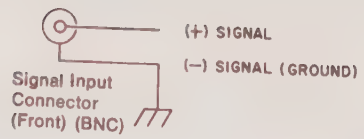
Unique Characteristics

Has internal jumper pins for front/rear input and normal/reverse polarity, upon which input attenuators can be installed.

SIGNAL INPUT

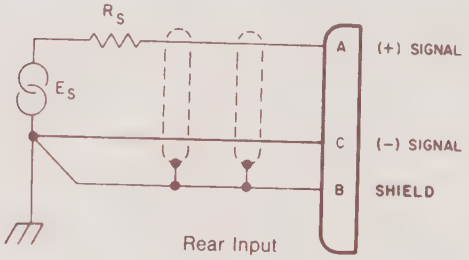
Signal input to module connections, Model 1858.

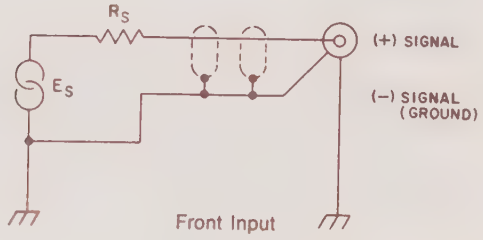




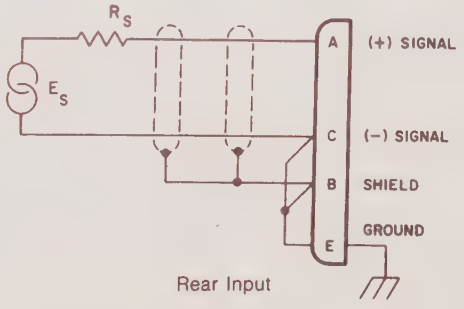
SUGGESTED CONNECTIONS

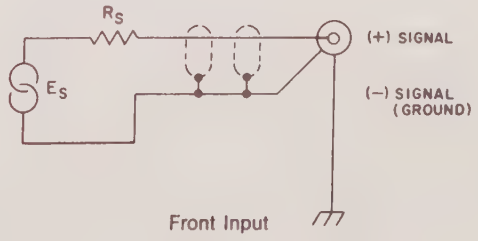
1. Source is single ended to ground (grounded at source).
   Note: With front BNC, no voltage difference may exist between source and recorder grounds.



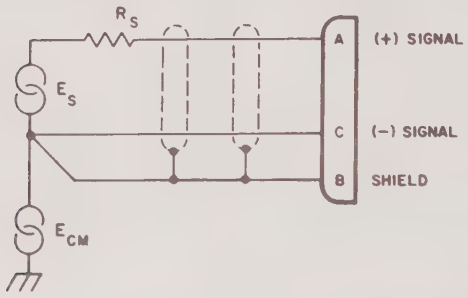


2. Source is floating, not driven off-ground, not grounded but can be, cannot be grounded at source.



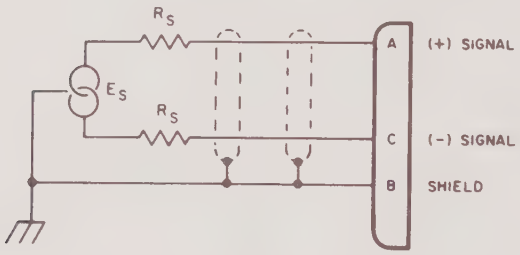


3. Source is floating and driven off-ground (Common Mode Voltages exist), cannot be tied to ground.

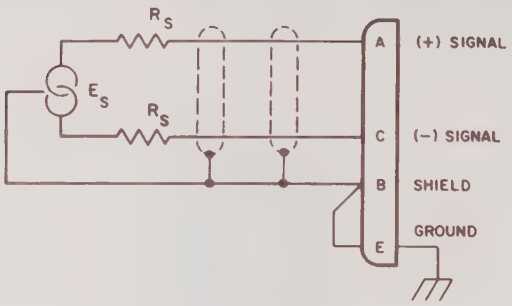


Note: Do not exceed maximum allowable Common Mode Voltage.

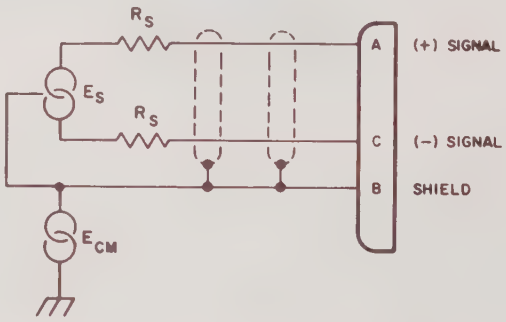
4. Source is balanced to ground, grounded at source.



5. Source is balanced and floating, not driven off-ground, not grounded but can be, cannot be grounded at source.



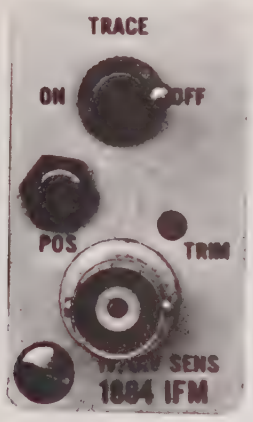
6. Source is balanced and floating, driven off-ground (Common Mode Voltages exist), cannot be tied to ground.

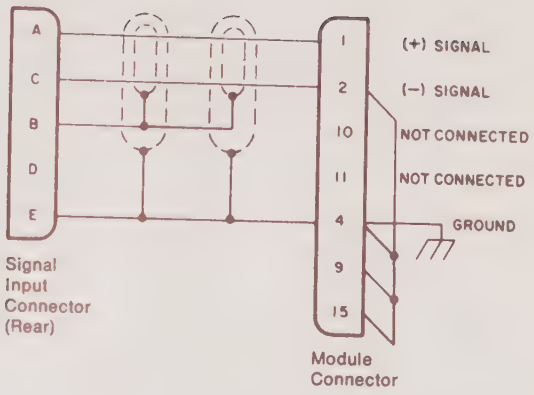


Note: Do not exceed maximum allowable Common Mode Voltage.

Model 1884—IFM Interface Module.

APPLICATION DATA





Description

The 1884-IFM adapts the 1858 system to signal sources (such as unique or existing signal conditioning units, voltage sources, etc.) where the source impedance is sufficiently low and the signal levels are sufficiently high that additional amplification and impedance matching are not required. The 1884-IFM consists only of the voltage-to-time converter portion of other signal conditioning modules. Sensitivity is ±1V/div (1 inch, 25 mm). The rear MS and front panel BNC connectors are connected in parallel in a single-ended, grounded configuration. It occupies a single module space in the 1858 system.

Type

Single ended to ground.

Primary Application

Has fixed sensitivity of ±1V/div for use with preconditioned signals that are or may be tied to ground.

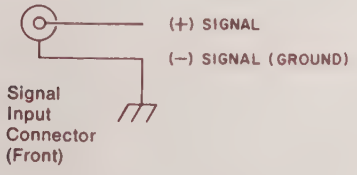
Note: No voltage difference may exist between source and recorder grounds.

Unique Characteristics

Consists of voltage to time converter only. Input impedance is 3.7 kΩ. With source impedances greater than 10Ω, 50 kHz spikes may be fed back to signal source, possibly precluding use in parallel recording from a common signal source.

SIGNAL INPUT

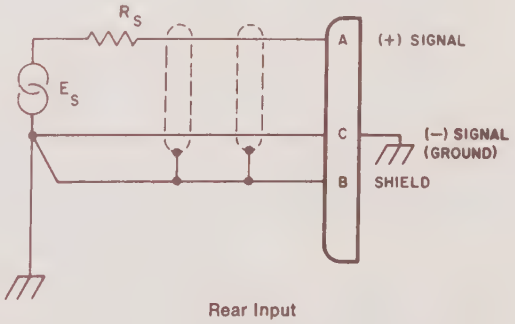
Signal input to module connections, Model 1858.



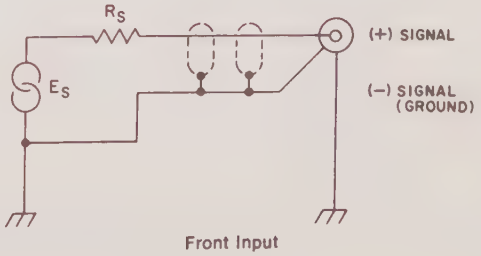
SUGGESTED CONNECTIONS

1. Source is single ended to ground (grounded at source).

Note: No voltage difference may exist between source and recorder grounds.

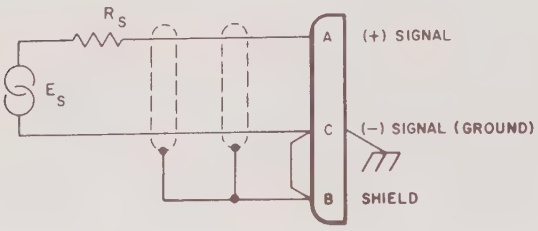


Rear Input

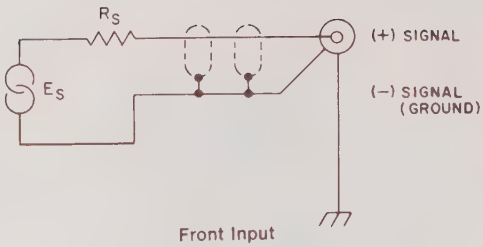


Front Input

2. Source is floating, not driven off-ground, not grounded, but can be tied to ground.



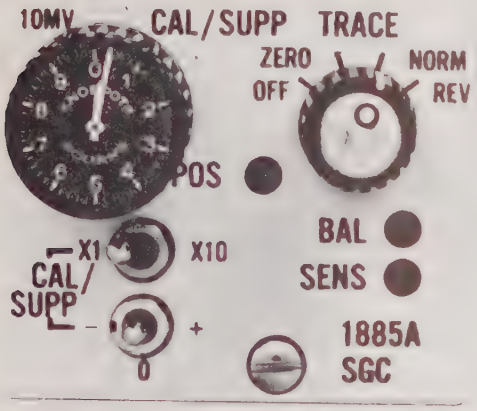
Rear Input



Front Input

Model 1885A — SGC Strain Gage Control Unit.

APPLICATION DATA



Description

The 1885A-SGC provides a convenient means for making accurate strain gage measurements with the 1858 system. In addition to signal amplification, the 1885A-SGC provides gage excitation and balance, as well as calibration and suppression of the input signals. Sensitivity is from 1 to 100 mV/div (1 inch, 25 mm). By changing internal jumper pins, the 1885A-SGC may also be used as a high-gain, differential dc amplifier with both calibration and suppression for low-level inputs. Its ability to be used with strain gage, thermocouple or other low-level signals makes it an ideal choice where flexibility is required. It occupies two paired module spaces (for example, channels 1 and 2) in the 1858 system

Type

Differential.

Primary Application

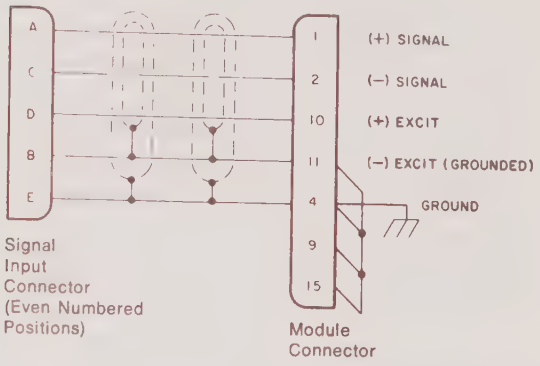
Complete (four arm) resistance bridges. May also be used with one, two and three arm bridges by providing bridge completion resistors external to the Model 1858. Properly connected, may also be used as a differential amplifier where no Common Mode Voltages exist.

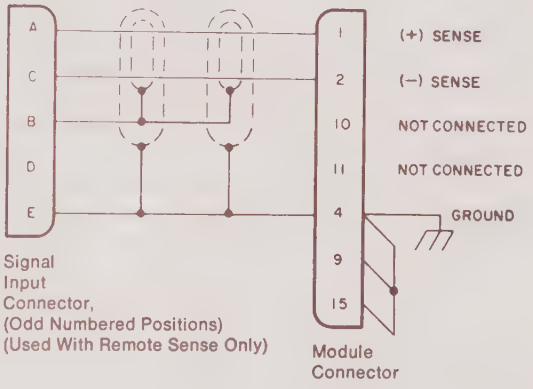
Unique Characteristics

Has front panel dial-in calibration and suppression, internal selection of 2.5, 5.0 or 10.0V gage excitation. Cannot be used with grounded gages as excitation negative (—) is tied to ground.

SIGNAL INPUT

Signal input to module connections, Model 1858.

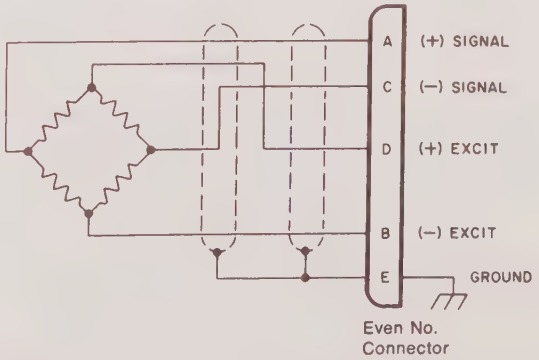




SUGGESTED CONNECTIONS

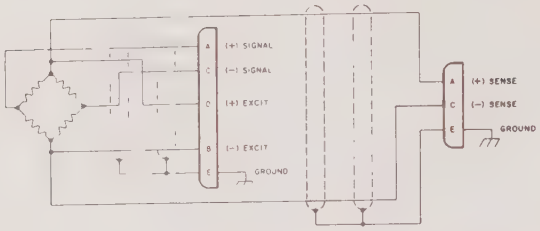
Strain Gage

1. Four external arm (full) bridge. Local sensing. Source must be floating and with negligible Common Mode Voltage. Bridge arms must be matched to within 0.5Ω for 120Ω gages, 4Ω for 350Ω gages.



Sense lead jumpers in 'local' positions, balance control jumpers 'in'.

2. Same as paragraph 1 but remote sensing.



Even No. Connector

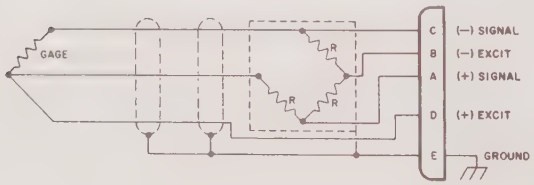
Odd No. Connector

Sense lead jumpers in "remote" positions, balance control jumpers 'in'.

3. One, two, three external arm bridges. Same arrangements and comments as para. 1. or 2. apply except that the bridge completion resistors must be provided by the user. Completion resistors or dummy gages are preferably placed at or near active gage arms to minimize thermal errors. Completion resistors must have temperature stability equal to or better than that of the active arms. Completion resistors should be matched to actual gage resistance within 0.5Ω for 120Ω gages, 4.0Ω for 350Ω gages.

4. Three wire, single arm gage. Must be floating and with negligible Common Mode Voltage. Completion resistors must be matched as stated in para. 3. above.

Note: This arrangement is not recommended because of low gage output and, while temperature-caused cable resistance changes are canceled, changes in temperature at the gage or at the completion resistors can cause large errors in relation to the low gage output. When this arrangement is used, gages and completion resistors must have very good temperature stability characteristics. Nevertheless, this arrangement is frequently used and, therefore, the connection arrangement is included.

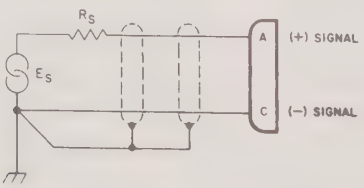


Even No. Connector

Sense lead jumpers in "local" positions, balance control jumpers "in".

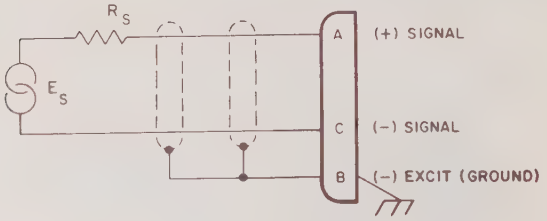
Differential Amplifier, Non-Strain Gage Applications

1. Source is single ended to ground (grounded at source).



Sense lead jumpers in "local" positions, balance control jumpers "out".

2. Source is floating, not driven off-ground, not grounded but can be.

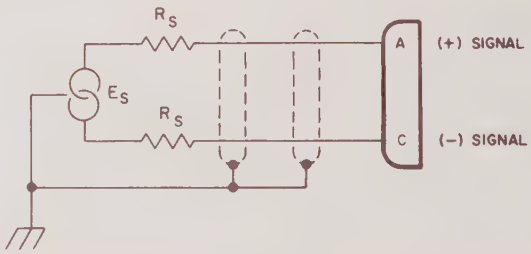


Sense lead jumpers in "local" positions, balance control jumpers "out".

3. Source is floating and driven off-ground (Common Mode Voltages exist), cannot be tied to ground.

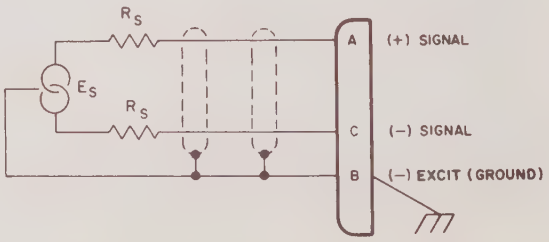
Model 1885A is not recommended in this arrangement.

4. Source is balanced to ground, grounded at source.



Sense lead jumpers in "local" positions, balance control jumpers "out".

5. Source is balanced to ground, not driven off-ground, not grounded but can be.



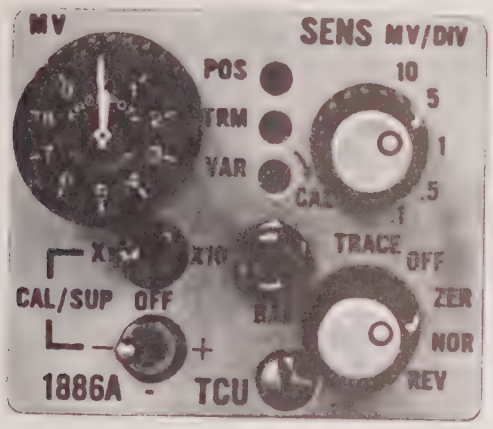
Sense lead jumpers in "local" positions, balance control jumpers "out".

6. Source is balanced and floating, driven off-ground (Common Mode Voltages exist), cannot be tied to ground.

Model 1885A is not recommended in this arrangement.

Model 1886A — TCU Thermocouple Control Unit and Microvolt Amplifier.

APPLICATION DATA



Description

The 1886A-TCU provides a convenient means of making accurate thermocouple-type temperature measurements or other measurements where the signal levels are in the microvolt region. In addition to its sensitivity range of from 100 μV to 50 mV/div (1 inch, 25 mm), the 1886A-TCU provides dial-in input calibration and suppression of 1 to 100 mV. By using this calibration and suppression capability, the nonlinearities of thermocouples can frequently be disregarded. Accessory thermocouple compensation units are available for the most commonly used thermocouple types. The 1886A-TCU occupies two paired module spaces (for example, channels 1 and 2) in the 1858 system.

Type

Differential.

Primary Application

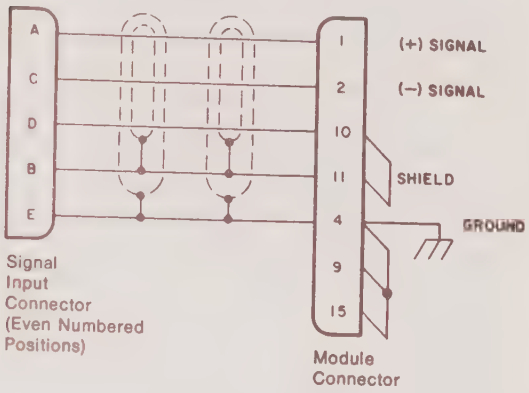
Thermocouple temperature measurements and other very low level signals.

Unique Characteristics

Maximum sensitivity of 100 μV/div on record. Dial-in calibration and suppression voltages. Limited frequency response on high sensitivity ranges. Requires ohmic path of not greater than 100 kΩ from signal input to ground to provide input amplifier bias current. Sometimes necessary to add this resistor externally. Can accommodate up to ±5V common mode.

SIGNAL INPUT

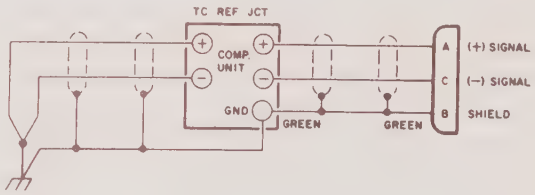
Signal input to module connections, Model 1858.



SUGGESTED CONNECTIONS

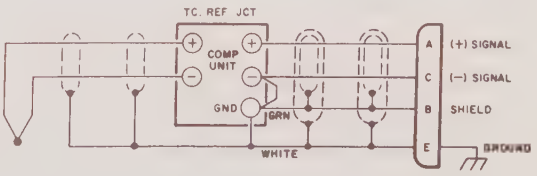
Thermocouple measurements using Honeywell Compensation Unit P/N 16778605 and 3 ft cable P/N 16778292-001 from Compensation Unit to the Model 1858. Compensation Unit is near the Model 1858.

1. Thermocouple is grounded at measuring point.

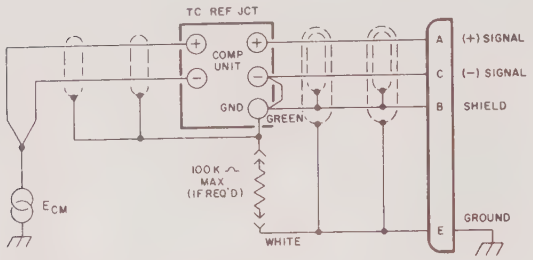


Isolate case of Compensation Unit from ground to avoid ground loop problems.

2. Thermocouple is floating, not driven off-ground, can be grounded, cannot be grounded at point of measurement.



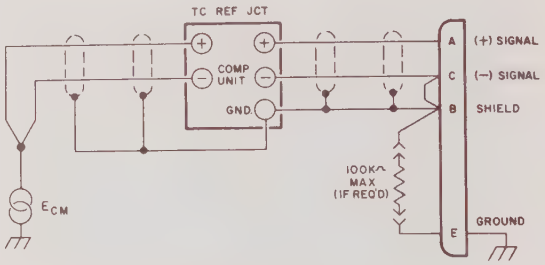
3. Thermocouple is floating, driven off-ground (Common Mode Voltages exist), cannot be tied directly to ground. 1886A requires no greater than 100 kΩ dc resistance path to ground for proper operation. Thus if common mode source is greater than 100 kΩ dc resistance, a resistive path will have to be separately provided.



Isolate case of Compensation Unit from ground to avoid shorting Common Mode Voltage to ground.

Note: Do not exceed maximum allowable Common Mode Voltage.

3. Themocouple is floating, driven off-ground (Common Mode Voltages exist), cannot be tied directly to ground. 1886A requires no greater than 100 kΩ dc resistance path to ground for proper operation. Thus, if common mode source resistance is greater than 100 kΩ dc resistance to ground, a resistive path will have to be separately provided.

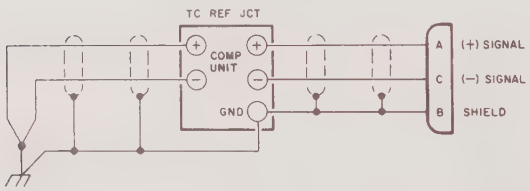


Isolate case of Compensation Unit from ground to avoid shorting Common Mode Voltage to ground.

Note: Do not exceed maximum allowable Common Mode Voltage.

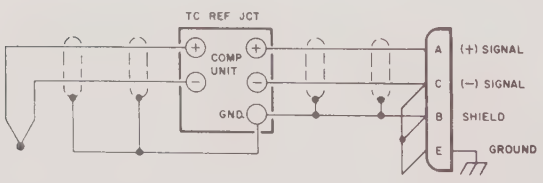
Thermocouples using Honeywell Compensation Unit P/N 16778605 with customer furnished cable from Compensation Unit to Model 1858. Compensation Unit located remote to Model 1858.

1. Thermocouple is grounded at measuring point.



Isolate case of Compensation Unit from ground to avoid ground loop problems.

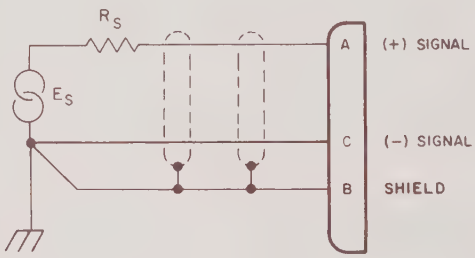
2. Thermocouple is floating, not driven off-ground, can be grounded, cannot be grounded at measurement point.



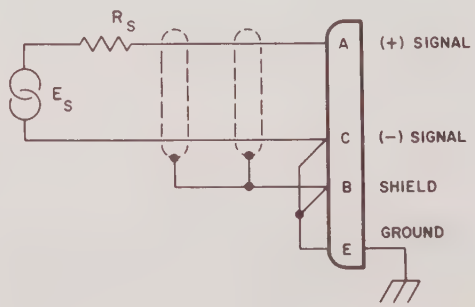
Isolate case of Compensation Unit from ground to avoid ground loop problems.

Used as amplifier for low level signals other than thermocouples.

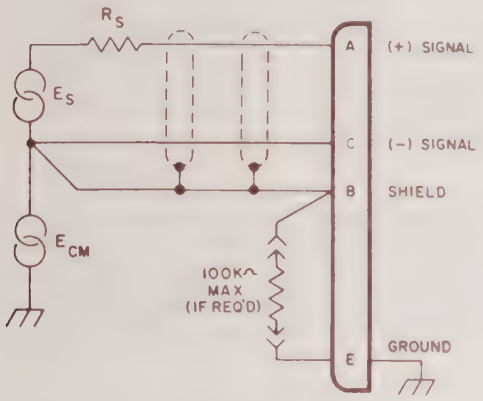
1. Source is single ended to ground (grounded at source).



2. Source is floating, not driven off-ground, not grounded but can be, cannot be grounded at source.

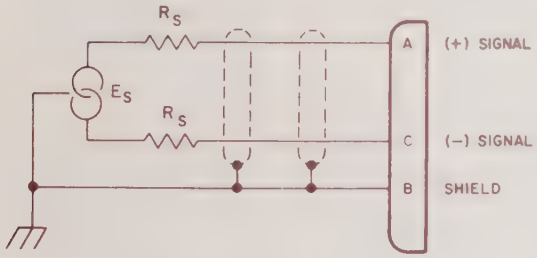


3. Source is floating and driven off-ground (Common Mode Voltages exist), cannot be tied directly to ground. 1886A requires no greater than 100 kΩ dc resistance path to ground for proper operation. Thus, if common mode resistance is greater than 100 kΩ dc resistance, a resistive path will have to be separately provided.

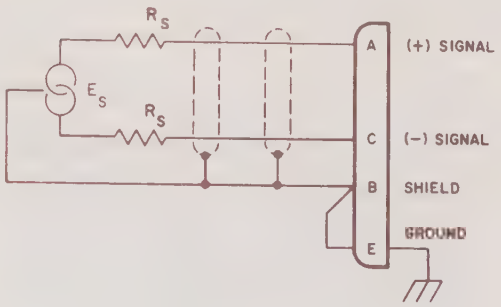


Note: Do not exceed maximum allowable Common Mode Voltage.

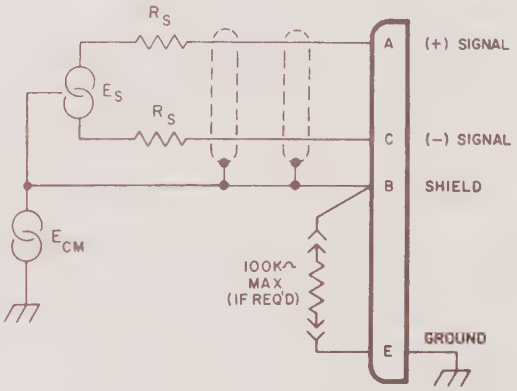
4. Source is balanced to ground, grounded at source.



5. Source is balanced and floating, not driven off-ground, not grounded but can be, cannot be grounded at source.



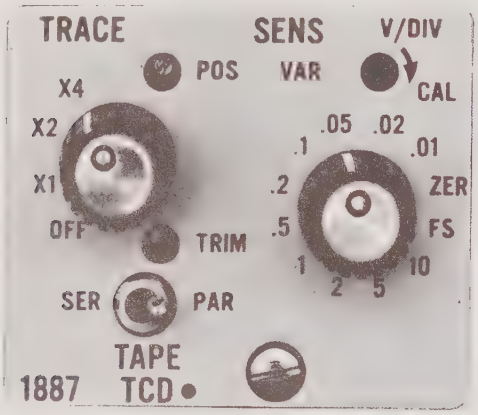
6. Source is balanced and floating, driven off-ground (Common Mode Voltages exist), cannot be tied directly to ground. 1886A requires no greater than 100 kΩ dc resistance path to ground for proper operation. Thus, if common mode resistance is greater than 100 kΩ dc resistance, a resistance path will have to be separately provided.



Note: Do not exceed maximum allowable Common Mode Voltage.

Model 1887A—TCD Tape Compatible Differential Amplifier Module.

APPLICATION DATA



Description

The 1887A-TCD is a high-sensitivity, wide gain-range, differential amplifier. It provides input signal conditioning, giving a system sensitivity of ±10 mV to ±25V/div (1 inch, 25 mm) and for ±1.414V (1V rms) output to the tape recorder. The 1887A-TCD occupies two paired module spaces in the 1858 system.

Type

Differential.

Primary Application

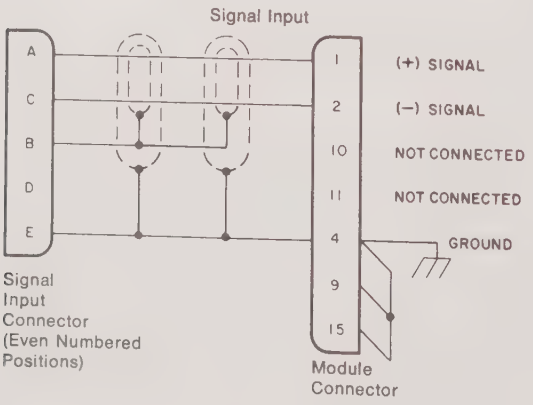
Conditions signals from 10 mV to 25V for serial or parallel recording on tape recorders and Model 1858 with Common Mode Voltages of ±5 or ±300V, depending on sensitivity selected. When used with tape recorder, no difference in potential may exist between tape recorder and Model 1858 grounds.

Unique Characteristics

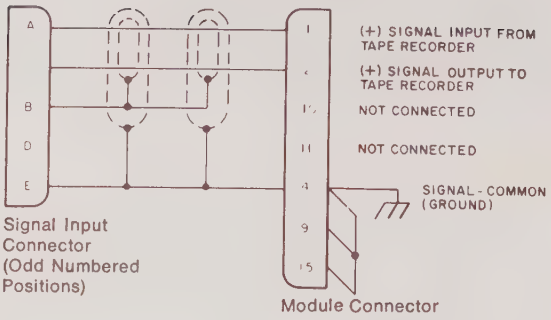
Has output to and input from tape recorder, front panel switches for parallel or serial recording, X1, X2 or X4 trace expand, and calibration signal.

SIGNAL INPUT

Signal input to module connections, Model 1858.

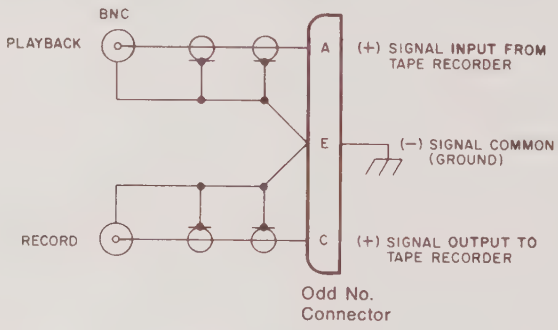


Tape Recorder Interface



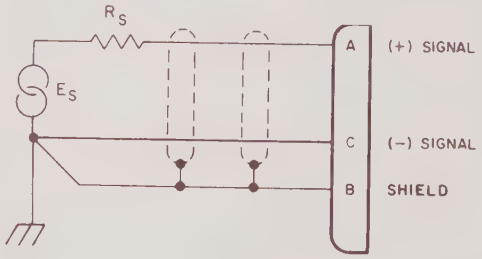
SUGGESTED CONNECTIONS

Tape recorder connections (usable with all signal input arrangements per the following connections). (Honeywell cable P/N 16791326-001 or equivalent)

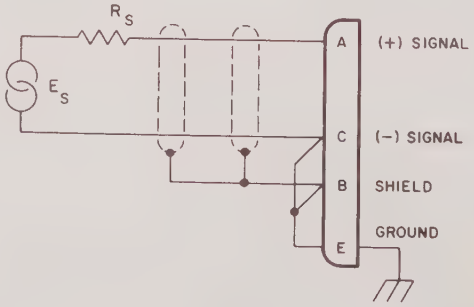


Signal input connections.

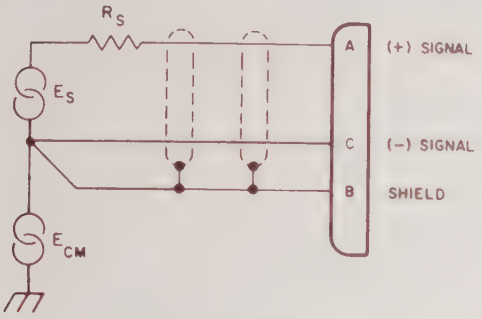
1. Source is single ended to ground (grounded at source).



2. Source is floating, not driven off-ground, not grounded but can be, cannot be grounded at source.

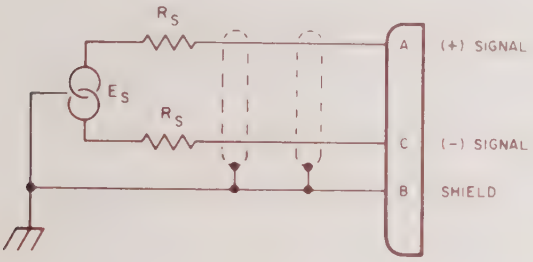


3. Source is floating and driven off-ground (Common Mode Voltages exist), cannot be tied to ground.

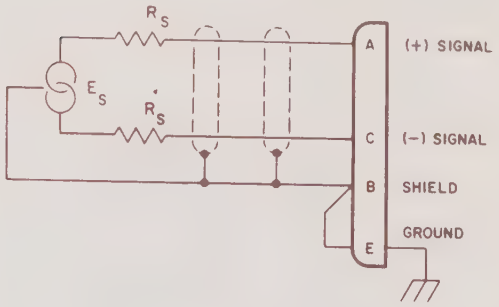


Note: Do not exceed maximum allowable Common Mode Voltage.

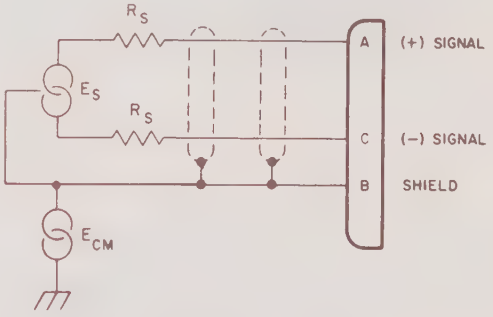
4. Source is balanced to ground, grounded at source



5. Source is balanced and floating, not driven off-ground, not grounded but can be, cannot be grounded at source.



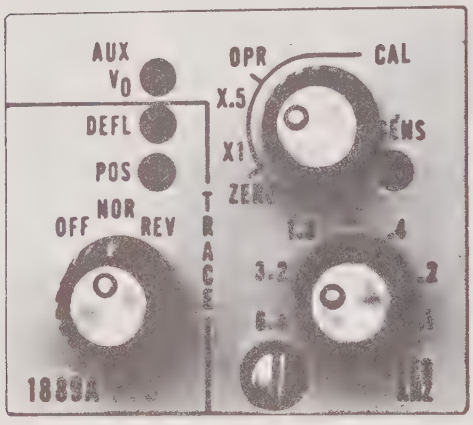
6. Source is balanced and floating, driven off-ground (Common Mode Voltages exist), cannot be tied to ground.

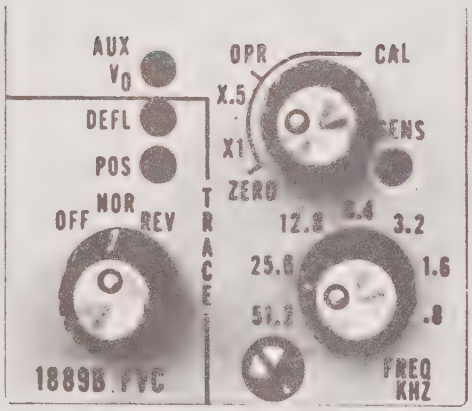


Note: Do not exceed maximum allowable Common Mode Voltage.

Model 1889A-FVC/1889B-FVC Frequency-to-Voltage Converter Modules

APPLICATION DATA





Description

The Models 1889A-FVC and 1889B-FVC provide a dc output directly proportional to the frequency, but independent of the amplitude, of an ac or pulsed dc input signal. Designed primarily for use with magnetic pulse type speed or flow transducers, the 1889 modules may be used as well to measure and record frequency or frequency deviation from other signal sources in a variety of applications.

In addition to producing analog recordings on the Model 1858 Visicorder oscillograph, an auxiliary output is provided for magnetic tape recording or for other recording, display, alarm or control purposes. The modules also feature a precision crystal oscillator having selectable frequencies for convenience and accuracy in set-up and calibration. Full scale frequency input can produce up to full width recording on the Model 1858 and up to +5.0V at the auxiliary output.

The Model 1889A-FVC has seven ranges to a maximum of 6.4 kHz input frequency. The 1889B-FVC also has seven ranges but to a maximum of 51.2 kHz. Both have selection of "fast" or "slow" response time.

The modules occupy two paired module spaces of the Model 1858. Signal input is to the even-numbered connector on the rear of the Model 1858; the auxiliary output is from the odd-numbered connector.

Type

Differential.

Primary Application

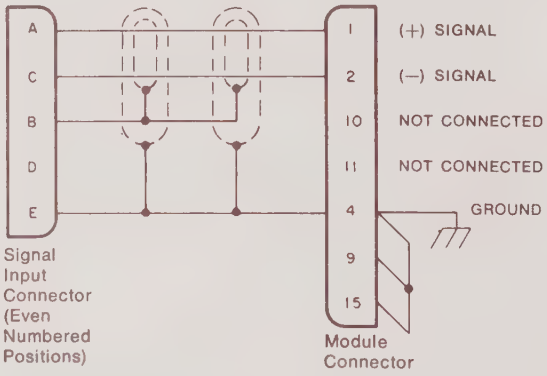
Converts ac or dc pulses from magnetic speed and flow meters to an output directly proportional to speed, flow, etc.

Unique Characteristics

Internal jumpers allow ac coupling to block dc levels. Has +5V auxiliary output; precision, internal calibration.

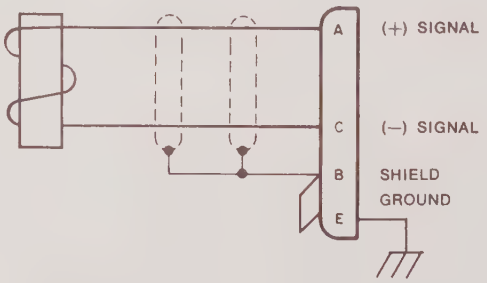
SIGNAL INPUT

Signal input to module connections. Model 1858.

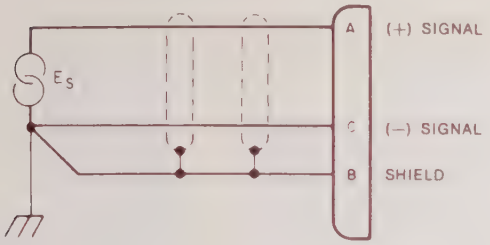


SUGGESTED CONNECTIONS

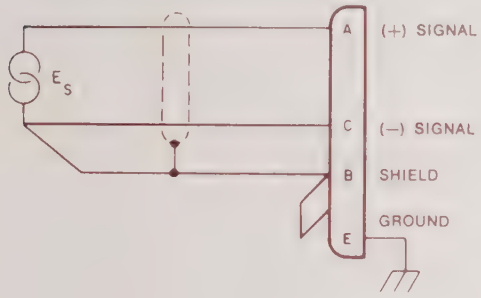
1. Typical magnetic speed or flow transducer.



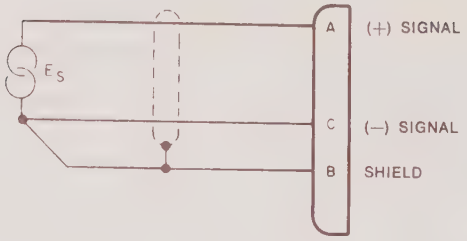
2. Source is single ended to ground (grounded at source).



3. Source is floating, not driven off ground, not grounded but can be, cannot be grounded at source

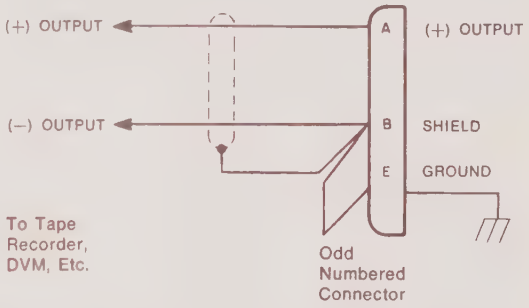


4. Source is floating, may not be grounded.



Note: Do not exceed maximum allowable common mode voltage.

5. Auxiliary output connection



Note: Maximum load (minimum resistance) 10 kΩ. When setting auxiliary output level using a meter that will be removed, the loading effect of the meter may be determined by:

$$\text{Loading effect in \%} = \frac{\left(\frac{12\,\text{k}\Omega \times R_L}{12\,\text{k}\Omega + R_L}\right)}{R_M}$$

Where: 12 kΩ = Aux. output impedance.
R_L = Load resistance in ohms.
R_M = Meter resistance in ohms.

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Honeywell

Rapid Access Improved UV Type Recording Paper

PRODUCT INFORMATION

Features

- Rapid trace appearance
- Excellent Stability—exceptional resistance to image fading
- May be photocopied directly — no wet processing necessary
- Improved contrast — darker traces, lighter background
- High writing speeds
- Fast delivery — stocked in Honeywell field service offices

The Honeywell Rapid Access Improved UV Type recording paper is the ideal Direct Print photorecording media for use with Honeywell Visicorder oscillographs equipped with mercury vapor lamps or fiber optic cathode ray tubes in applications where on-line visible data access, record permanence, or the ability to make copies are important considerations. The excellent characteristics of the Improved UV Type recording paper offer improved contrast by producing darker traces on a lighter background. High writing speed capability is also achieved—a feature extremely helpful in recording transient signals.

The Rapid Access recording paper described in this data sheet replaces all previous Honeywell recording papers and is readily identified by the notation "RAPID ACCESS IMPROVED UV TYPE" printed on the end of the box.

Record Latensification

The ability to display data within seconds of the actual recording is accomplished by combining the characteristics of the Honeywell Rapid Access Improved UV Type paper with the illumination from latensifier lamp accessories available for all Honeywell Visicorder oscillograph models. While the highest contrast records are obtained by slow latensification, such as from room lighting, increasing the light level to reduce latensification time does not detract from the record's contrast, writing speed, and permanence as severely as with the earlier rapid access type paper.

Slow latensification is accomplished by permitting the record to exit into fluorescent room lighting. The recorded traces will start to appear in five to ten seconds and, over a period of several minutes of continued latensification, will continue to increase in density while the pale yellow background changes to a light buff color. Record latensification in this manner yields the highest writing speeds, greatest contrast, best photocopies, and maximum resistance to image fading. *Shielding the record from direct light for a few inches as it exits from the Visicorder oscillograph further improves contrast as the unexposed background area is allowed to become partially desensitized before being subjected to higher light levels.*

Normal latensification is accomplished by placing the Visicorder oscillograph's latensifier lamp approximately 6 to 10 inches away from the recording paper as it exits from the recording point. Using latensifier lamps having both "black-light" and white lamps, the white lamps only should be turned on, the "black light" lamps being used only for rapid latensification. The recorded traces will start to appear in approximately 3 to 5 seconds and, over a period of several minutes of continued latensification, will continue to increase in density and lighten in background in much the same manner as with slow latensification. (See Cautions)

Rapid latensification *is not recommended when the best record quality is required.* It is accomplished in the same manner as for normal latensification, except that both latensifier lamps are turned on, and the latensifier to paper distance may have to be decreased. The recorded traces will appear in approximately 1 to 3 seconds and, with continued latensification, will continue to increase in density while the background changes to a light grayish color. Since trace appearance time is dependent upon the wavelength and intensity of the latensification light, the rate at which the image appears decreases as the record moves away from the brightest area of illumination. *The maximum writing speed capability and contrast of the paper are reduced as the rate of latensification is increased.* (See Cautions). The use of heated platens available for earlier Visicorder oscillograph models does not significantly reduce latensification time or otherwise improve the characteristics of the Honeywell Rapid Access paper and, therefore, is not required.

Record Copying

The high contrast and excellent permanence of the Honeywell Rapid Access paper permits fully latensified records to be photocopied on a variety of commercial or business copying machines without intervening processing steps. Several copies can be made from the original record without noticeable record degradation. Where a considerable number of copies are required, it is recommended that the first copy be substituted as the original and the required additional copies made from it. In addition to protecting the original recording, the succeeding copies usually have greater trace density and lighter background.

Best photocopy results are obtained using "green lamp" copying machines, such as Xerox Models 6601, 720, 813, 910, 914 and 1860. The Xerox Model 1860 provides continuous roll copying of one or more rolls simultaneously (maximum 36" width) and will provide 1:1 copies or 2:1 reduction as desired. Good copies may also be made with "white lamp" Xerox machines, Fleet, Royfax, IBM and Bruning 2000. In any case, the user should be cautioned to experiment with a record sample to determine whether the desired results will be achieved before attempting to copy valuable records. Honeywell Rapid Access recording paper cannot be reproduced by Diazo or similar methods.

The contrast of the copy can be enhanced, and fading significantly reduced, by placing a thin, transparent sheet of yellow or amber plastic between the record and the copier light source. The use of this material to cover records while exposed to room lighting, or when using back lighted record viewers, will reduce fading.

One such transparent yellow material, "ZELAR Y", stock number 4765-417A, manufactured by Gladwin Industries, Atlanta, GA, is available from most office stationery stores.

Wet Processing

Honeywell Rapid Access Improved UV Type recording paper cannot be wet processed. Its excellent characteristics have eliminated wet processing requirements for most applications. Records will last indefinitely if protected from light. Under normal fluorescent or incandescent room lighting, fully latensified recordings will be retained for several days without significant loss of contrast. The recording paper also has greatly improved resistance to sunlight and is therefore ideal for outdoor field test applications.

In those applications where wet processing is required, Kodak Type 1801 (standard) or Kodak Type 1799 (extra thin) may be used. While the direct print characteristics are not equal to the RAPID ACCESS type, good wet chemical processed records can be obtained. Wet processing instructions are included in the recording paper box.

Writing Speeds

The Rapid Access Improved UV Type recording paper yields optimum performance in Honeywell Visicorder oscillographs equipped with the high pressure mercury vapor lamp or fiber optic cathode ray tube. In a properly adjusted mercury lamp Visicorder oscillograph, writing speeds as high as 75,000 inches per second may be realized, and greater than 500,000 inches per second in the fiber optic cathode ray tube models.

Cautions

(1) When used with Honeywell fiber optic cathode ray tube recorders (1806 Series, 1856 Series, LS-6 Series, 1858) the record should not be subjected to high-level illumination, such as from the latensifier lamp or overhead fluorescent lights, as it exits from the Visicorder oscillograph. Instead, the record should immediately be "shaded" for a few inches from the exit and only indirect lighting allowed to reach the shaded area. This allows the unexposed record area to become slightly desensitized to light in the visible spectrum and prevents background darkening caused by excessively rapid latensification or other high-level lighting. In moving mirror (galvanometer) oscillographs, this "desensitization" is partially accomplished by "scatter" light in the Visicorder oscillograph. This "scatter" light is not present in the cathode ray type Visicorder oscillographs.

(2) Exposure to light prior to recording will reduce emulsion sensitivity; therefore, loading should be accomplished in subdued room lighting. As an added precaution, the paper roll should be advanced two to three turns after loading. For slow speed recording, or where the Visicorder oscillograph will be in stand-by mode with periodic recordings made, subdued ambient lighting is preferred. It is recommended that a short burst of paper be run to clear the outer layers that may have become slightly pre-exposed.

(3) The Rapid Access Improved UV Type recording paper is NOT recommended for the following applications:

(a) *Gray scale recording, such as infrared mapping, etc., with the Honeywell linescan recorders 1806 Series, 1856 Series or LS-6 Series.* Kodak Linagraph Direct Print paper, Type 1895 (standard) or Type 2022 (extra thin), having somewhat wider gray-scale capability, should be used.

(b) *Extremely slow speed recordings of less than 0.1 inch per second paper speed.* Blue sensitive papers such as Kodak Linagraph Direct Print (Kodak Stock Number prefix 142), Kodak 1799, Kodak 1801, or equivalent should be used.

(c) *Extremely high writing speeds with the 1806 Series, 1856 Series or LS-6 Series.* Kodak Linagraph Direct Print paper, (Kodak Stock Number prefix 142), or equivalent should be used.

(d) *Visicorders using tungsten (i.e. 1406) or Xenon (i.e. modified 1508, 1912) light sources.* Use Kodak Type 1895, 2022, or equivalent.

(4) Recordings made on the "standard" base paper will yield an apparent contrast greater than those made on the "extra thin" base. The standard paper has an opaque white background whereas the extra thin is somewhat translucent.

(5) All recording papers will become desensitized and/or fogged if stored in a high temperature environment. Store in a cool, dry location. Do not leave on loading docks, trunks or seats of automobiles, etc. where very high temperatures are frequently encountered.

Ordering Information

Note: Because the "Improved UV" recording paper is identical to the earlier rapid access type in all respects for operational use in Honeywell Visicorder oscillographs, the Honeywell part numbers have remained unchanged. Honeywell Rapid Access Paper is Kodak Type 2167 (standard), Type 2295 (extra thin) packaged in the Honeywell Box for ready availability through Honeywell, Test Instruments Division, factory and field service locations.

Visicorder oscillograph Model	Size	Paper Weight	Spool Spec.	Honeywell Part No.
906, 1406, 1806, 1856, 2106, 2206, LS-6	6" x 100'	Std.	2	16774562-610
906, 1406, 1806, 1856, 2106, 2206, LS-6	6" x 150'	Std.	2	16774562-615
906, 1406, 1806, 1856, 2106, LS-6	6" x 200'	Extra thin	2	*16774562-620
1108	8" x 200'	Std.	2	16774562-802
1108	8" x 350'	Extra thin	2	16774562-835
1508, 1858	8" x 100'	Std.	2	16774562-810
1508, 1858	8" x 200'	Extra thin	2	16774562-820
1012, 1612, 1912	12" x 200'	Std.	2	16774562-122
1012, 1612, 1912	12" x 400'	Extra thin	2	16774562-124

*Do not use in 2206—diameter too large

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SECTION 2

INSTALLATION

2-1. GENERAL

This section contains unpacking, installation, and packing instructions for the Model 1858 CRT Visicorder. Instructions for rack mounting, power and control signal connections, checkout, and installation of the latensifier option are also included.

2-2. UNPACKING

Use reasonable care in unpacking the instrument. After unpacking, carefully inspect the instrument for visible shipping damage. If any damage is observed, immediately report the damage to the carrier and to your Honeywell representative.

WARNING

When the cradle door is open use care to avoid scratching or marring the FO-CRT face plate.

2-3. INSTALLATION

A. GENERAL

The recorder is designed for conventional bench mounting, and requires only sufficient horizontal space near a power outlet and the connection of the input signals. Figure 2-1 shows the basic outline dimensions of the recorder. Since the 1858

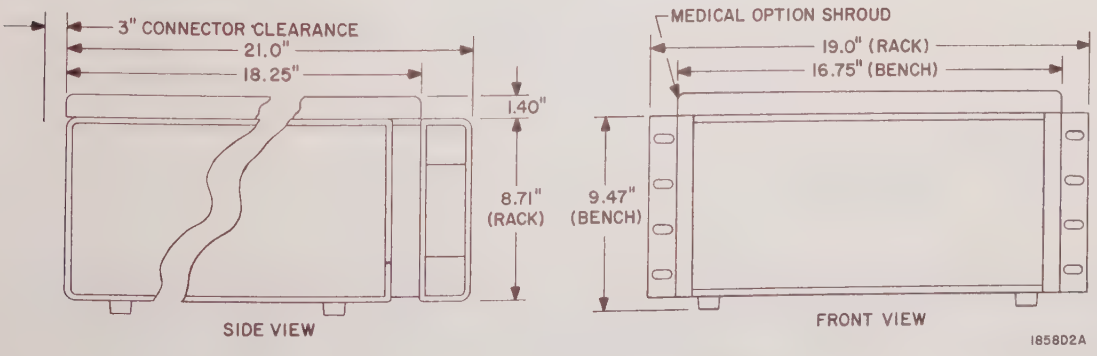


Figure 2-1. Dimension Diagram

CRT Visicorder contains no blowers or fans, it is entirely dependent upon convection cooling. Adequate clearance must be maintained as follows:

1. Bench Use.

   a. The clearance between the bottom of the instrument and bench, as established by rubber feet, must be maintained. Place nothing under instrument.

   b. Nothing should be placed on top of instrument and a minimum of four inches should be maintained between the top, sides, and rear of the instrument and other objects such walls, other instruments, etc.

2. Rack Use.

   a. A minimum of one and three-fourths inches must be maintained between the top and bottom of the instrument and other devices installed within the rack. If the other devices are heat producing, greater spacing should be provided.

   b. A minimum of one inch is required on each side and four inches at the rear.

   c. If the rack contains a significant amount of other heat producing equipment, it should be adequately lowered and/or equipped with forced air cooling.

CAUTION

Consult the manual(s) for the signal conditioning modules to be used before connecting the input data signals. DO NOT INSTALL OR REMOVE ANY MODULE OR CIRCUIT CARD WHILE THE MODEL 1858 POWER SWITCH IS ON.

B. RACK MOUNTING

With the optional rack mounting equipment, the recorder can be installed in a standard 19-inch RETMA rack cabinet. The recorder requires 8-3/4 inches of vertical space in the rack. To install the rack assemblies and mount the recorder, refer to Figure 2-2 and the following procedure:

1. Remove the black pressure sensitive tape from around the front section of the instrument.

2. Remove the bottom cover.

3. Remove the four rubber feet from the bottom of the recorder and store these items for possible future use.

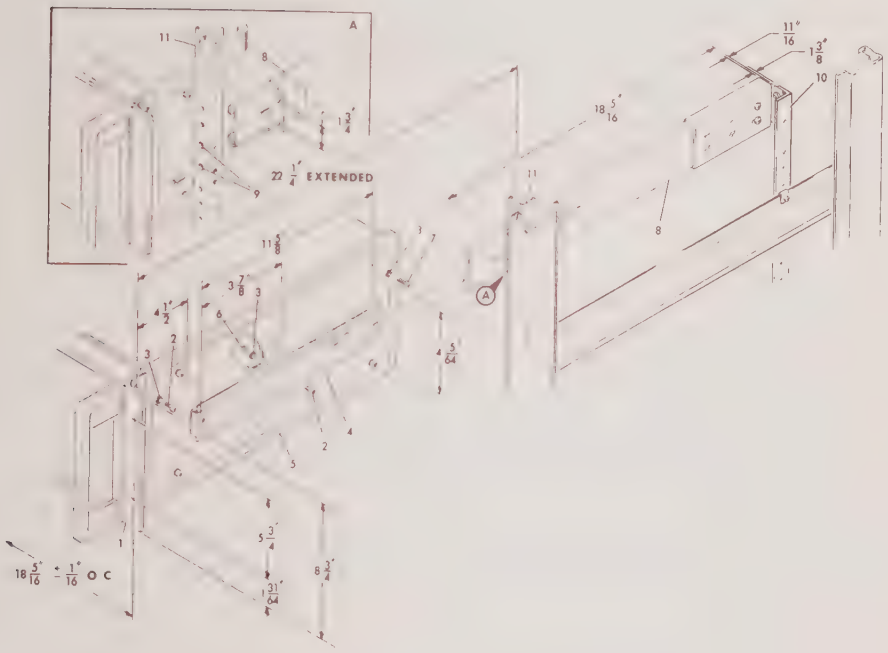


Figure 2-2. Rack Mounting

4. Reinstall the bottom cover.

5. Install the right side rack stop bracket (1) with two 10-32 x 7/16-inch pan head screws (2) and two #10 internal tooth lockwashers (3).

6. Remove the right side instrument cover.

7. Remove the inner rail (4) of the slide assembly for the right side and attach it to the right side cover (5) with three 10-32 x 7/16-inch screws (2), three #10 internal tooth lockwashers (3), and three 10-32 nuts (6).

   Verify inner slide is mounted with catch towards rear and slide is mounted towards the bottom of the side cover when installed. Holes in side used for inner rail attachment are not in center, but closer to one edge than the other.

8. Install the slide mounting cover prepared in step 6 with four pan head 1-32 x 1/2-inch screws (7) and four #10 internal tooth lockwashers (3). Slide of inner rail must be located towards bottom of the Model 1858.

9. Repeat steps 5 through 8 for the left side of the instrument.

10. Figure 2-3 shows standard cabinet rail hole pattern. Determine where stop bracket and slide mounting holes are to be located. Holes in stop brackets and slide mounts must match with cabinet rail holes. If they do not match, 1858 Visicorder must be repositioned properly.

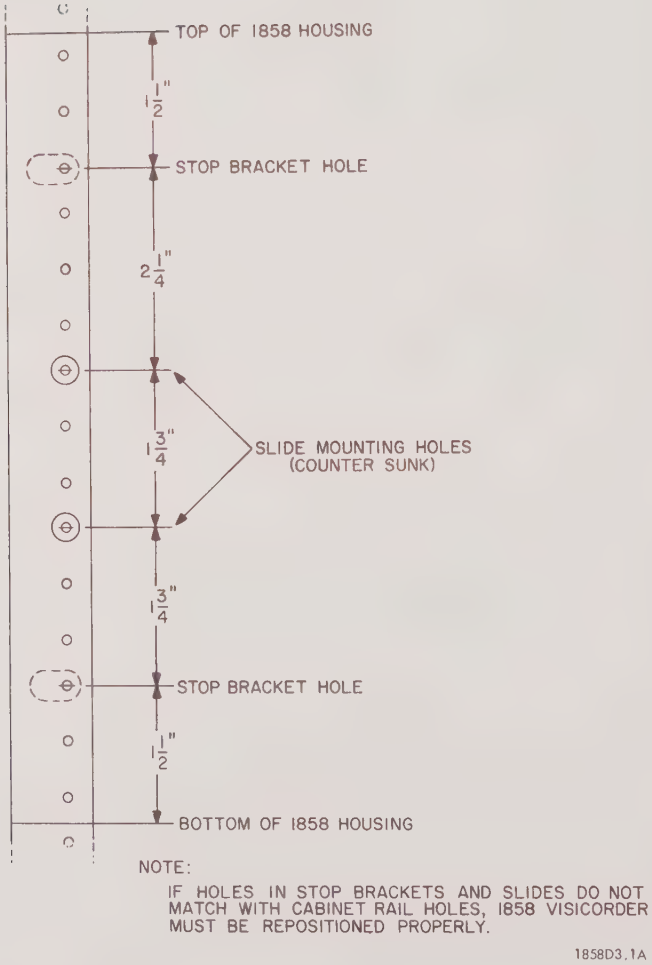


Figure 2-3. Rack Mounting Hole Pattern

11. Position the vertical cabinet rail (10) at a distance 18-5/16 inches from the back of the front vertical rail (11).

12. Install the outer rails of the slide assemblies (8) in the rack cabinet using the mounting hardware packaged with the slide assemblies.

13. Extend the moveable portion of the outer rail to the position where the out locks engage.

CAUTION

Ensure that the rack cabinet has an antitilt base, or is otherwise supported to prevent the entire installation from falling over when the recorder is extended from the cabinet.

14. With the help of an assistant, lift the recorder into position in front of the rack and start the inner slide rails into the rack mounted outer slides.

15. Slide the recorder into the rack slides until the slide locks engage. Release the locks and slide the instrument all the way into the rack. Check the alignment of the slides and make adjustments as necessary.

16. Connect the power and input control signals (TIMELINE and RECORD DRIVE inputs if required) according to paragraph 2-4. Insure that the POWER pushbutton is off.

CAUTION

Do not remove or install any plug-in module or circuit card while the Model 1858 POWER pushbutton is on.

17. Consult the manuals (s) for the plug-in modules to be used in the Model 1858 and determine the data channel assignments. The channel assignments may be recorded on the inside of the paper door. If it is desired to make the signal connections through the rear panel, the input signal cables may be installed at this time. After positioning the modules, tighten their front panel mounting screws.

2-4. POWER AND CONTROL SIGNAL CONNECTIONS

A. POWER CONNECTION

All Model 1858 instruments are shipped configured for 120 Vac nominal operation. At the time of installation, the configuration should be verified or modified if 220 Vac operation is desired.

B. EXTERNAL RECORD DRIVE CONNECTIONS

1. For remote control of the start/stop function of the Record Drive connect a remote switch to the DRIVE BNC connector on the upper rear panel. Record speed can be controlled by presetting the front panel controls or by using the following provision for an external record drive speed signal. Set the LoCaL/ReMoTe switch to ReMoTe.

2. If the use of an external record drive speed signal is desired, the signal is connected through the RECORD DRIVE input BNC connector located on the bottom of the rear panel. The required signal input is a positive dc voltage sufficient to produce a 40μ A current flow for each inch per second of the desired record speed. Approximately 9.6 Vdc will produce 120 ips. Figure 2-4 shows a sample circuit.

C. EXTERNAL TIMELINE SIGNAL INPUT

If the timeline option is present and the use of an external timeline control signal is desired, the signal is connected through the rear panel TIMELINE input BNC connector. Figure 2-5 shows a timeline input signal. Front panel TIMELINE switch must be in the EXTernal position.

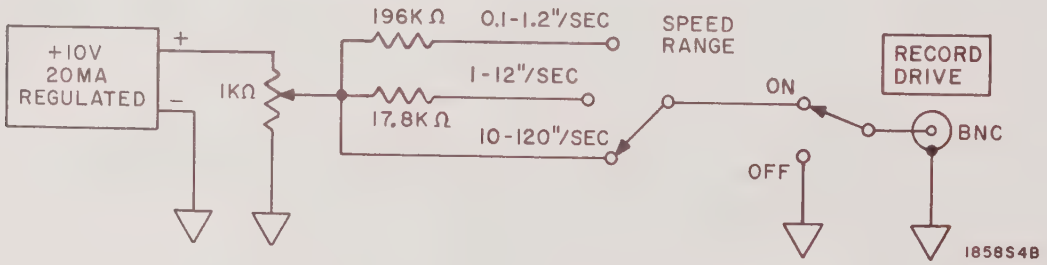


Figure 2-4. Sample External Record Drive Set Up

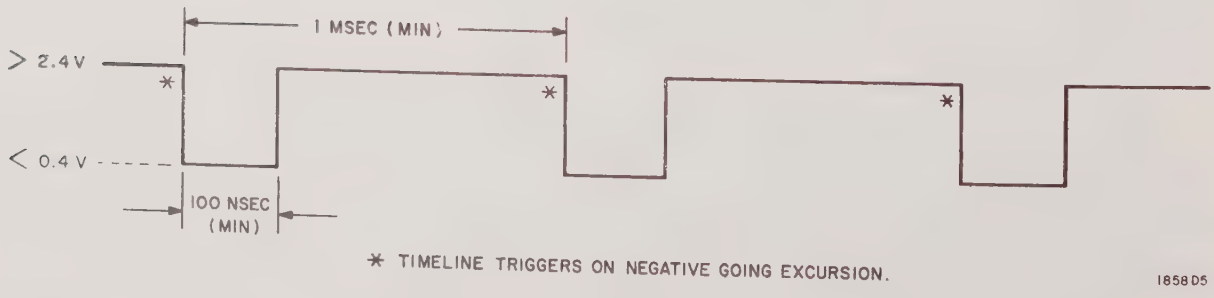


Figure 2-5. Timeline Input Signal (Typical)

2-5. CHECKOUT PROCEDURE

Determine that the instrument is in good operating condition after shipment by using the following procedure.

A. PREPARATION

1. POWER and DRIVE pushbuttons released.

2. Connect the power cable as described in paragraph 2-4.A.

3. Load the recording paper as described in paragraph 3-3.A. The instructions are repeated on the inside of the paper door.

4. Set the recorder controls as follows:

   a. GRIDLINE, TIMELINE, and RECORD TIMER switches to OFF.

   b. All RECORD SPEED and MULTIPLIER pushbuttons released.

5. Verify that jumper J1 on the 32-channel trace identifier circuit card A3A2 is in the proper position (C to 1 for 18 channel operation and C to 2 for 32 channel operation).

B. CHECKOUT

1. Press the POWER pushbutton to on. Observe that the POWER pushbutton lights up and the PAPER meter moves to indicate the supply of paper.

2. Set the GRIDLINE switch to CONT.

3. Lock in the x 0.1 MULTIPLIER pushbutton.

4. Lock in the RECORD SPEED pushbutton for 1 IN/SEC.

NOTE

Steps 5 through 10 check out the record drive system by observation of record speed changes. It is not necessary to run extended lengths of paper.

5. Lock in the DRIVE pushbutton. Observe that the pushbutton lights and the record begins to mode.

6. Press and lock in the MULTIPLIER pushbutton for x 1.0, and observe increase in the rate of paper motion.

7. In sequence, press and lock in individually the RECORD SPEED pushbuttons for 2, 4, 8, and 16 IN/SEC. Observe the changes in rate of paper motion.

8. Simultaneously, press and lock in the RECORD SPEED pushbuttons for 2 IN/SEC and 8 IN/SEC. Observe the change in paper speed.

9. Press and lock in individually the pushbutton for 2 IN/SEC. This action releases the pushbutton for 8 IN/SEC.

10. Press and lock in the x 10.0 MULTIPLIER pushbutton. Observe the rapid paper motion, then release the DRIVE pushbutton.

11. Observe the recording completed in step 10. The gridline pattern should be present for the full length of the recording. See Figure 3-2.

12. Press and lock in the x 0.1 MULTIPLIER pushbutton.

13. Set the RECORD TIMER switch to 15 SEC.

14. Press and lock in the DRIVE pushbutton. The record should drive for about 15 seconds (±6 seconds) and stop automatically.

15. Advance the RECORD TIMER to 60 SEC.

16. Set the GRIDLINE switch to OFF.

17. Release the DRIVE pushbutton and then lock it in again. The record should drive for about 60 seconds (±6 seconds) and stop automatically. No gridlines should be present on the record.

18. Release the DRIVE pushbutton and return the RECORD TIMER to OFF.

NOTE

If the timeline option is not present, omit steps 19 through 35.

19. Set the TIMELINE switch to AUTOmatic.

20. Press and lock in the RECORD SPEED pushbutton for 8 IN/SEC.

21. Press and lock in the x 10.0 MULTIPLIER pushbutton.

22. Press and immediately release the DRIVE pushbutton. Observe the timeline pattern (Figure 3-2) and the absence of any interval identifying mark.

23. Press and lock in the x 1.0 MULTIPLIER pushbutton.

24. Press and release the DRIVE pushbutton Observe the timeline pattern with one interval identifying mark on the accented tenth line.

25. Press and lock in the x 0.1 MULTIPLIER pushbutton.

26. Press and release the DRIVE pushbutton. Observe the timeline pattern with two interval identifying marks on the accented tenth line.

27. Press and lock in the RECORD SPEED pushbutton for 1 IN/SEC.

28. Set the GRIDLINE switch to INTD.

29. Press and lock in the DRIVE pushbutton. Allow the record to run for about 15 seconds.

30. Release the DRIVE pushbutton and observe the timeline pattern with three interval identifying marks on the accented tenth line. Also observe that gridlines are printed for only 1/16 inch (approximately) after each timeline.

31. Set the TIMELINE switch to 10 SEC.

32. Set the GRIDLINE switch to OFF.

33. Press the DRIVE pushbutton and allow the record to run for about 100 seconds.

34. Observe the timeline pattern with four interval identifying marks on the accented tenth line.

35. Set the TIMELINE switch to OFF.

NOTE

If the trace identifier option is not present, omit steps 36 through 39.

36. Verify that jumper J1 on the trace identifier circuit card is in the proper position. C-1 for Model 1858 operation and C-2 for Model 1858 and 1870 operation.

37. Turn on a few of the plug-in modules. Input signals are not required for the following procedure. Adjust module controls to place static traces on the record. See module manual (s) for adjustment procedure.

38. Press the DRIVE pushbutton and run about 30 inches of record.

39. Observe the repeated identification of the channels which were turned on in step 36. See Figure 3-2.

40. Release the POWER switch.

2-6. LATENSIFIER INSTALLATION

When a latensifier is required to speed the appearance of the traces on direct print records, mount the latensifier assembly on the upper portion of the left handle bracket near the connector FOR 58L. Hand tightening of the latensifier clamp should be sufficient. Connect the latensifier power plug to the connector FOR 58L. Adjust the lamp assembly so that the light from the latensifier falls directly onto the record as it comes out of the instrument during recording. Pushbuttons on the lamp assembly turn the latensifier lights on or off.

2-7. METRIC UNITS

Metric designations for the RECORD SPEED pushbuttons are located below the pushbuttons on the front panel and use a conversion ratio of 1 inch equals 2.5 cm. Using the same ratio, the spacing of the gridlines at 0.2 inch intervals equals 0.5 cm intervals.

2-8. PACKING AND SHIPPING

Should it become necessary to repack the recorder for shipment or long term storage, proceed as follows:

A. Disconnect and remove all connecting cables; and remove accessory and optional equipment such as the latensifier, rack mounting hardware, supply (and take-up) spindles, etc.

NOTE

If the recorder is being returned to the factory do not ship items removed in step A.

B. Enclose the recorder in a plastic bag with dessicants inside, and seal the bag.

C. Place the instrument in a heavy duty corrugated cardboard carton having approximately the same inner dimensions as the oscillograph.

D. Pack dunnage, rubberized horsehair, or air bubble on all sides of the oscillograph so that all open spaces are filled and tightly packed.

E. Seal the inner carton and place it in an extra strength outer carton or wooden crate. The outer carton must be large enough to allow a minimum of two inches for dunnage on all sides of the inner pack

F. Be sure the dunnage is packed tightly and that no voids remain.

G. Seal the outer package. Mark FRAGILE and THIS SIDE UP to designate normal instrument operating position.

NOTE

The packing method used must also conform to the regulations and specifications of the carrier used. When transporting the recorder into or through severe environments, provide additional packing, as required.

SECTION 3

OPERATION

3-1. GENERAL

This section provides general operating procedures for the Model 1858 CRT Visicorder. These procedures will provide the operator with a basic understanding of the capabilities of the recorder. With this information, the recorder can be readily adapted to specific applications. A description of the controls and connectors is also included.

3-2. CONTROLS AND CONNECTORS

A. GENERAL

Operating controls and signal connectors are located on both the front and rear panels as shown in Figure 3-1. The following descriptions of the controls are keyed to Figure 3-1.

B. DESCRIPTIONS

1. Connector FOR 58L Latensifier

A three-pin connector used to supply power for the operation of the optional latensifier when it is present.

2. PAPER Indicator

An electric meter indicates the portion of full capacity remaining in the paper magazine. The meter is calibrated for the Empty reading. Various sizes of full rolls may give slightly different Full readings.

3. TIMELINE Switch

An eight-position switch used to select the time interval between timelines. This switch is present on all instruments even though the timeline option is not included.

OFF - Timelines not printed.

.001 through 10 - One timeline printed each fraction or multiple of a second according to switch position. Every tenth line is accented and marked to indicate the selected timeline interval. See Figure 3-2.

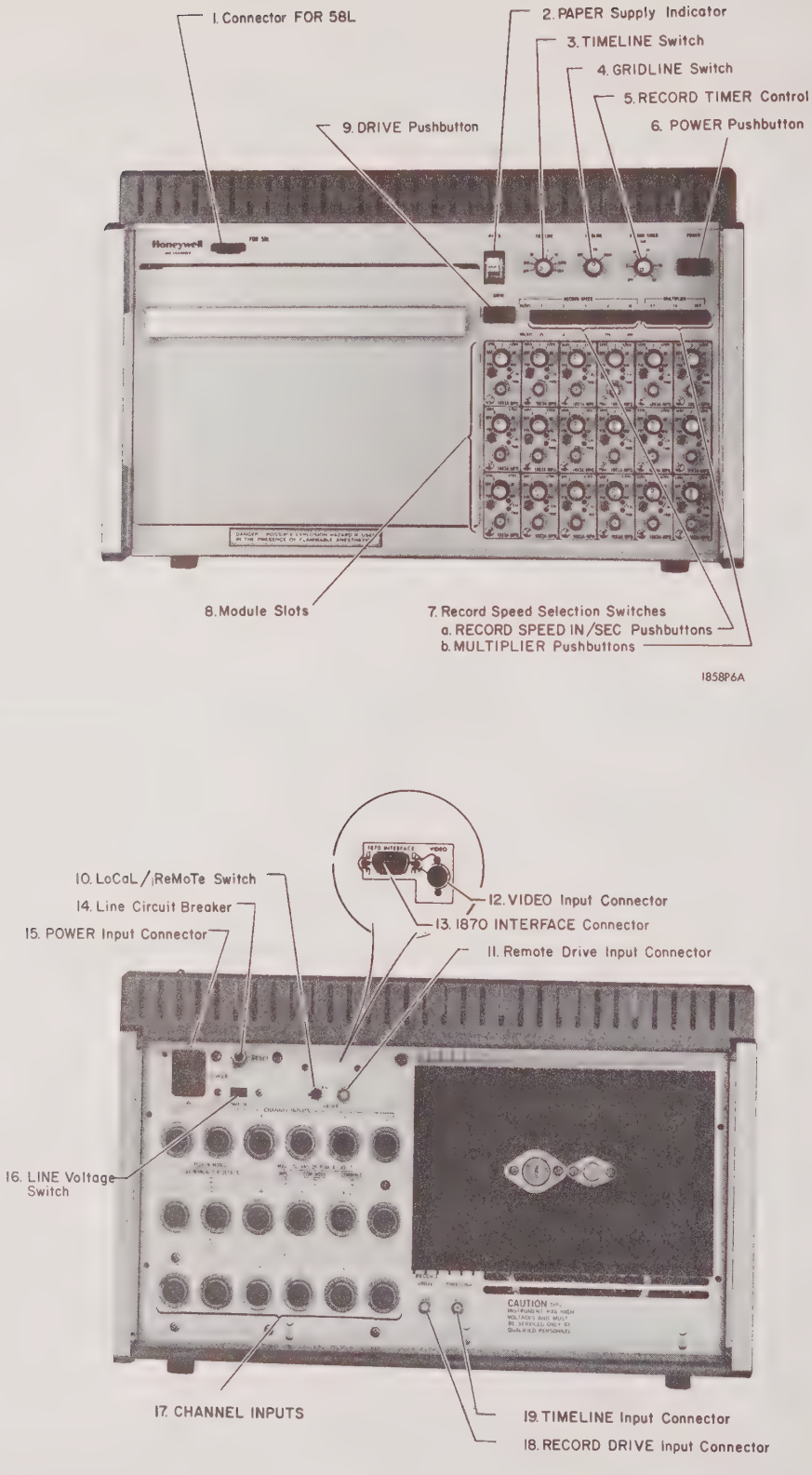


Figure 3-1. Model 1858 Controls and Connectors

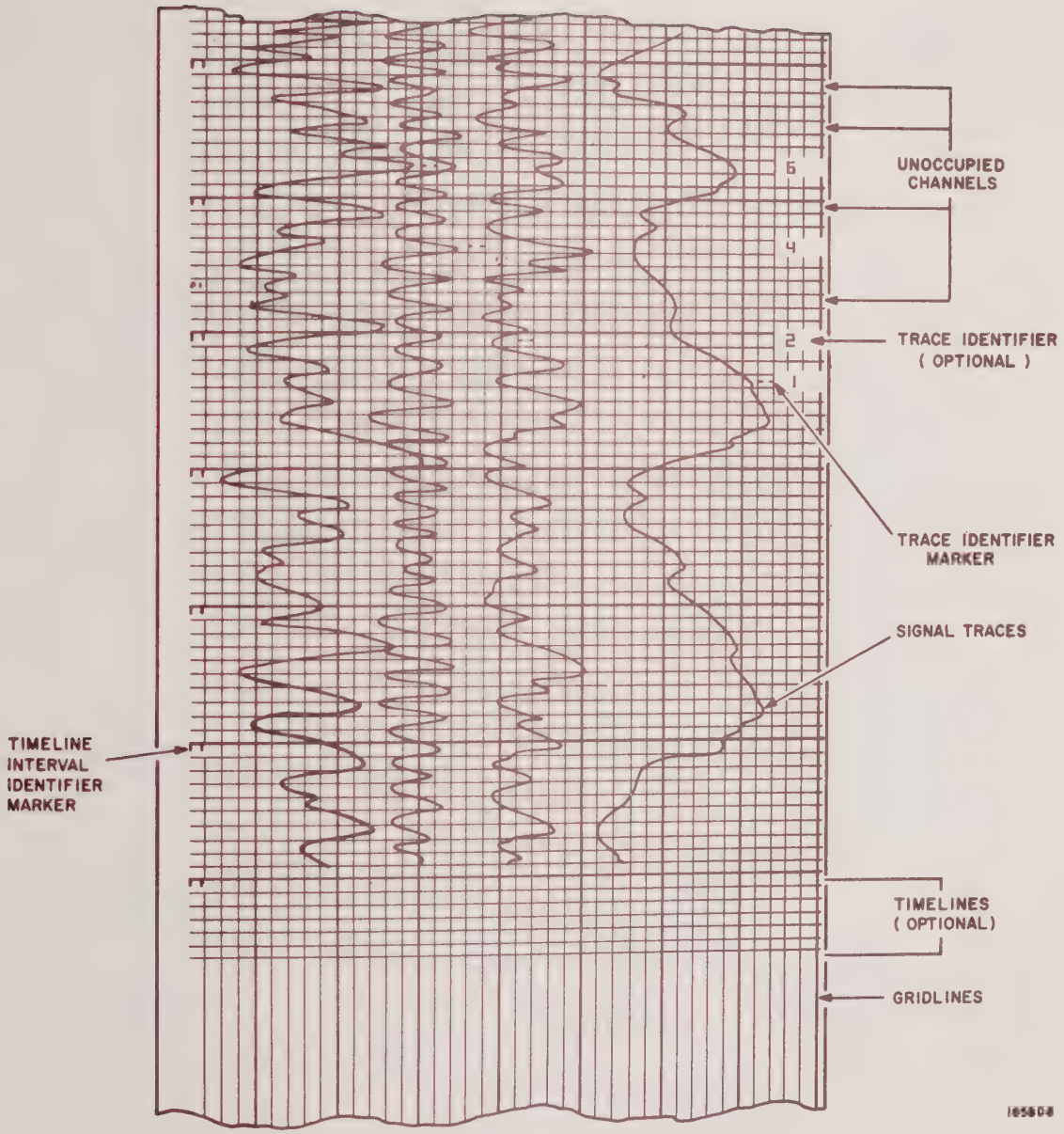


Figure 3-2. Sample Recording

INTERVAL MARKS	SELECTED INTERVAL (sec)
0	.001
1	.01
2	.1
3	1.0
4	10.0

AUTOMATIC - Timelines automatically printed at predetermined interval according to the record speed selected.

RECORD SPEED (ips)	TIMELINE Interval (sec)
80 to 120	.001
8 to 70	.01
0.8 to 7	.1
0.1 to 0.7	1.0

Every tenth line is accented and marked to identify the timeline interval.

EXTernal - Disables internal timeline signals. Timelines do not print unless a suitable external signal is connected to the rear panel TIMELINE connector. Every tenth line is accented, but the interval markers are disabled.

4. GRIDLINE Switch

A three-position switch controls the gridlines. See Figure 3-2.

OFF - Gridlines do not print.

INTerrupteD - If the timeline option is present and in use, this position allows the gridlines to print for only 1/16 inch (approximately) after each timeline. If the option is not present or in use, the gridlines print continuously. Every fifth line is accented.

CONTinuous - Gridlines print continuously and every fifth line is accented.

5. RECORD TIMER Control

Sets running time for record drive servo. When the DRIVE switch is pressed after this control is set to a selected time, the record drives for the selected length of time and stops automatically. The DRIVE switch must be released and pressed again to initiate another recording. In the OFF position, this control allows the DRIVE switch full control over the duration of a recording.

6. POWER Pushbutton

A press-to-lock pushbutton controls all power to the instrument. When the pushbutton is locked in, it lights to show that power is actually applied to the instrument.

7. Record Speed Selection Switches

Two groups of pushbuttons are used to select the record drive speed. At least one switch in each group must be engaged for the record drive servo to function in the local mode. If remote speed control is desired, all switches in both groups must be released.

a. RECORD SPEED IN/SEC Pushbuttons

Five pushbuttons individually select speeds of 1, 2, 4, 8, and 16 in/sec. The effect of two or more switches may be added. For example, the 1 and 2 pushbuttons may be engaged simultaneously to get a drive speed of 3 in/sec or 4, 8, and 16 may be engaged simultaneously to get a drive speed of 28 in/sec. Metric markings below the pushbuttons identify them as 25, 50, 100, 200, 400 mm/sec.

b. MULTIPLIER Pushbuttons

Three mutually exclusive pushbuttons select multiplying factors of 0.1, 1.0, or 10.0 for the record speed selection. For example, if the RECORD SPEED pushbutton for 8 IN/SEC is pressed, the MULTIPLIER pushbuttons determine the actual record drive speed of 0.8, 8.0, or 80.0 in/sec.

8. Module Slots

These slots are for the installation of selected signal conditioning plug-in modules. Up to 18 single slot modules may be used. Channel designations (1 through 18) run from left to right, top to bottom. Refer to the manual(s) for the selected modules before installing any module or connecting any signal cables.

CAUTION

Do not remove, install, or connect any module while system power is on.

9. DRIVE Pushbutton

A press-to-lock switch which starts the record drive servo and allows CRT unblanking when engaged. The record continues to drive until the DRIVE pushbutton is released unless the RECORD TIMER or a remote RECORD DRIVE signal is used.

10. LoCaL/ReMoTe DRIVE Switch

This switch allows the transfer of the start/stop drive function to a remote switch. Speed control is maintained by the front panel switches unless an external RECORD DRIVE signal (See 18. below) is also used.

11. Remote Drive Input Connector

This BNC connector is provided to allow connection of a remote (ON/OFF) drive switch.

12. VIDEO Input Connector (Optional)

When the Model 1870 Amplifier Housing is used to provide additional plug-in capacity, this connector receives the processed data signals from the modules located in the additional plug-in module capacity, this connector receives the processed data signals from the modules in the housing for display by the Model 1858. This option is not present on Underwriter's Laboratories listed units.

13. 1870 INTERFACE Connector (Optional)

When the Model 1870 Amplifier Housing is used to provide additional plug-in module capacity, this connector permits the routing of synchronization signals to the modules located in the housing and the return of signals for the trace identification system. This option is not present on Underwriter's Laboratories listed units.

14. Line Circuit Breaker

The line circuit breaker protects the primary of the main power transformer. When the breaker is tripped, the button must be pressed to resume operation.

15. POWER Input Connector

A three-prong grounding connector for the input of facility power of the instrument.

16. LINE Voltage Switch

A two-position slide switch allows setup of the instrument for operation on the nominal voltages of either 120 Vac or 220 Vac. If the input power is known to be consistently and significantly lower than the nominal voltage, rearrangement of internal transformer connections may be required for optimum performance.

17. CHANNEL INPUTS

A 5-pin connector for each of the 18 front panel plug-in module slots. Any signal connected here is routed directly to the associated slot for conditioning by the module installed.

CAUTION

See the signal connection information for the particular module(s) in use before connecting any signal cables. In some cases, the CHANNEL INPUTS are actually used as output connectors. For example, strain gage excitation voltages up to 10V may be routed through this connector.

18. RECORD DRIVE Input Connector

A BNC connector allows the use of an external drive signal to control the speed of the record drive servo if all of the RECORD SPEED and MULTIPLIER switches are released and the DRIVE switch is engaged.

19. TIMELINE Input Connector

A BNC connector allows the use of an external timing signal if the timeline option has been included and the TIMELINE switch is set to EXTernal.

20. TRACE IDENTIFIER Jumper (Not shown)

Jumper J1 in the C to 1 position allows for a 1 to 18 channel trace count (Model 1858 operation) and in the C to 2 position allows for a 1 to 32 channel trace count (Model 1858 and 1870 operation).

3-3. PRELIMINARY PROCEDURES

A. PAPER LOADING

Consult the illustration on the inside of the paper door and load paper according to the following procedure.

1. Open the paper door.

2. Remove the take-up spindle. This spindle is present only when the internal take-up option is included.

3. Release the cradle latch.

NOTE

Always release the DRIVE pushbutton before opening the cradle door. When the cradle door is open, the servo drive is disabled. However if the DRIVE pushbutton is engaged, the servo will be activated as the cradle door is closed.

4. Remove the supply spindle. Ensure that the core of the paper roll is clear, then insert the supply spindle into the roll.

NOTE

When both spindles are present, the supply spindle may be identified by the brake assembly at the middle of a thin shaft. The take-up spindle has a solid shaft.

5. Place the loaded supply spindle in the slots in the supply cradle with the paper unwinding forward from the top of roll. Spindle ends are positioned in the vertical slots, flat sides to the back.

6. Unroll enough paper to fold it over the cradle door, and close the cradle door, while pulling the paper to straighten the paper exit path.

7. If the instrument is not equipped with the internal takeup or if the use of the internal take-up is not desired, the instrument is ready for operation with the outer door either closed or open.

8. If the internal take-up is used, tear the loose end of the recording paper to a point in the center.

9. Place the take-up spindle in its slots with the recording paper down behind the spindle. Pull the paper snug and straight.

10. Press and lock in the RECORD SPEED pushbutton for 2 IN/SEC and the x 0.1 MULTIPLIER pushbutton.

11. Ensure that the LoCaL/ReMoTe switch (rear panel) is in the LoCal position. Press and lock in the POWER and DRIVE pushbuttons.

12. Hold the paper against the take-up spindle and allow the point of the paper to be rolled up between the spindle and the paper.

13. Ensure that the paper is feeding evenly onto the take-up spindle as the tension develops.

CAUTION

If the cradle door is opened while the paper is installed, it is necessary to redevelop tension according to steps 11 through 13 before attempting operation.

14. Release the DRIVE pushbutton. The recorder may be operated with the outer door opened or closed.

3-4. OPERATION

A. LOCAL

NOTE

Set the rear panel LoCal/ReMoTe switch to LoCal.

1. Verify that jumper J1 on the 32-channel trace identifier circuit card A3A2 is in the proper position (C to 1 for 18 channel operation and C to 2 for 32 channel operation).

2. After completion of paper loading procedure and the connection of the input signals, allow a 1 minute warm-up period.

3. During the warm-up period, adjust the trace positions and amplitudes as required. Make a few test recordings using typical input data signals (if possible) to determine these adjustments and the best operating record drive speed.

NOTE

When setting the trace positions and amplitude it is not necessary to run paper. Open the paper supply door, press the DRIVE pushbutton, and observe trace and amplitude on the FO-CRT face. Do not close paper supply door while in the DRIVE mode.

4. Set the GRIDLINE, RECORD TIMER, TIMELINE (optional), and latensifier (optional) switches as required. The instrument is ready for operation.

NOTE

Trace amplitude measurements should be referenced to the gridlines for greatest accuracy. Use of a scale may introduce errors of interpretation due to slight nonlinearities in the display presentation of the CRT.

B. REMOTE OPERATION

Two independent but compatible provisions are made for remote operation. A LoCaL/ReMoTe switch and a BNC connector on the upper rear panel provide for a remote RECORD DRIVE switch to control the start/stop and CRT blanking functions. Record speed can be preset by the normal front panel switches or by connecting an external record drive speed signal to the lower rear panel RECORD DRIVE Input BNC connector.

NOTE

Using only the external record drive speed signal is not recommended because normal blanking of the CRT does not occur during idle intervals and useful CRT life can be greatly diminished.

1. Set the LoCaL/ReMoTe DRIVE switch to ReMoTe.

2. Connect a single-pole, single-throw remote switch at the Remote Drive BNC connector.

3. Set the selected operating speed on the front panel switches, or release all RECORD SPEED IN/SEC and MULTIPLIER pushbuttons and connect an external record speed drive signal as described in paragraph 2-4. B.

4. All other procedures are the same as local operation.

3-5. RECORD PROCESSING

The direct print paper recommended for the Model 1858 will allow recordings to be read within 30 seconds when the record is exposed in a normal fluorescent lighted room. More rapid access may be achieved by use of the optional latensifier. These records should be protected from continuous exposure to ambient light and/or high temperatures to preserve record contrast.

Some applications may suggest the use of other recording papers or processes. In these situations, consult your Honeywell representative for specific information before utilizing new materials.

3-6. OPERATOR'S MAINTENANCE

A. CLEANING

Normal laboratory cleanliness standards should be applied for the Model 1858. In addition, the paper cradle area of the unit should be vacuumed occasionally.

B. LAMP REPLACEMENT

Both the POWER and the DRIVE pushbutton switches contain indicator lamps. These are long life lamps and should seldom need replacement. In the event of a lamp failure proceed as follows:

1. Remove the pushbutton lamp lens by pulling forward on the button.

2. Remove the lamp from the switch and insert an identical replacement lamp.

3. Reinstall the lens button by pressing it firmly in place.

CAUTION

Frequent circuit breaker tripping is indicative of more serious malfunctions and should be referred to qualified maintenance personnel for trouble-shooting and repair.

C. LATENSIFIER LAMP REPLACEMENT

If the optional latensifier is in use and lamp failure is experienced, replace the faulty lamp with the identical lamp identified in paragraph 3-7. Insure that power to the latensifier is off before inserting the new lamp.

SECTION 4

PRINCIPLES OF OPERATION

4-1. GENERAL

This section describes the overall functional operation of the Model 1858 CRT Visicorder. The functional analysis identifies and describes the subsystems or loops that perform specific operations. The functional analysis is followed by detailed analyses of the circuits that form each subsystem. Simplified circuit diagrams are included to illustrate component interaction, circuit groupings, and actual logic function. Schematics of the circuits are presented in Section 7.

4-2. FUNCTIONAL ANALYSIS

The Model 1858 CRT Visicorder is composed of the following four basic functional systems:

- Power Supplies
- Paper Transport Servo
- Trace Display
- Reference Line Generators

Figure 4-1 shows the routing of signals throughout the Model 1858 unit. The trace display system is made up of the clock, video amplifier, high voltage, and the CRT assemblies. This system processes the data signals from the individual plug-in modules for presentation by the CRT to the recording paper. Operating signals for control of the CRT beam sweep, intensity, and system synchronization are developed within the trace display system. The gridline generator and optional timeline and trace identification assemblies form the reference line generator system and develop signals for reference lines and identification markers presented on the recording.

Figure 4-2 shows a representation of a highly magnified section of a recording made on a Model 1858. This view shows the dot and dash components of the display presentation which are not noticable at actual record size. As described in the separate plug-in module manuals, the input data signals are processed by the voltage-to-time converters within each module into these components according to slewing rate of the signal and synchronized with the CRT beam sweep (ramp) for accurate positioning on the recording. The reference signals generated by the gridline (and optional timeline and trace identification) circuits are also presented in the dot and dash component form.

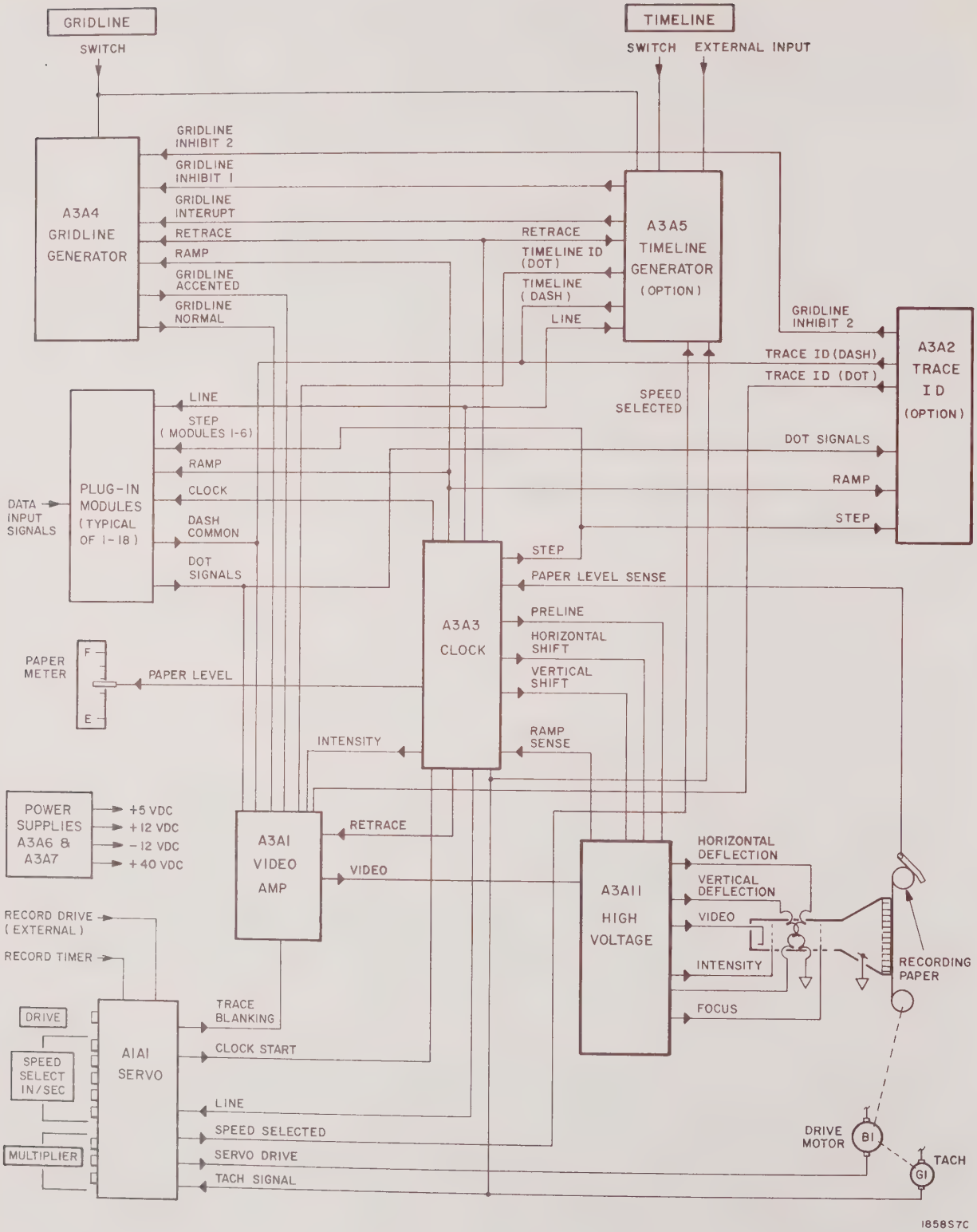


Figure 4-1. Model 1858 Block Diagram

The paper motion, selected by front panel pushbuttons, is servo-controlled to provide an accurate time base along the length of the record.

The power supplies develop the required regulated dc operating voltages from either 120 or 220 Vac nominal input. The dc voltages developed include 5, ±12, and 40 Vdc.

4-3. POWER SUPPLIES (Figure 7-8)

The Model 1858 CRT Visicorder accepts either 120 or 220 Vac nominal line voltage and develops four regulated dc voltages (5, ±12, and 40 Vdc) for operation of the basic recorder and distribution to the signal conditioning plug-in modules. Three of the low voltage supplies are dependent in the following sequence; -12V, 12V, and 5V. For instance, if a fault causes the loss of the -12V supply, both of the succeeding supplies are also affected. The 40V power supply is independent.

A. POWER INPUT

The input power is connected through the POWER connector A15J1 to the POWER pushbutton switch. When the POWER switch is engaged, the input is routed through the line circuit breaker A15CB1 and the LINE Voltage switch A15S1 to the primary windings of transformer A3T1. Depending on the LINE Voltage switch position, the transformer windings are connected in series for 230 Vac operation or in parallel for 115 Vac operation. In either switch position, 115 Vac is routed from A3T1 pins 1 and 15 to the connector FOR 58L A1J1 pins 1 and 3 to make power available for operation of the optional latensifier.

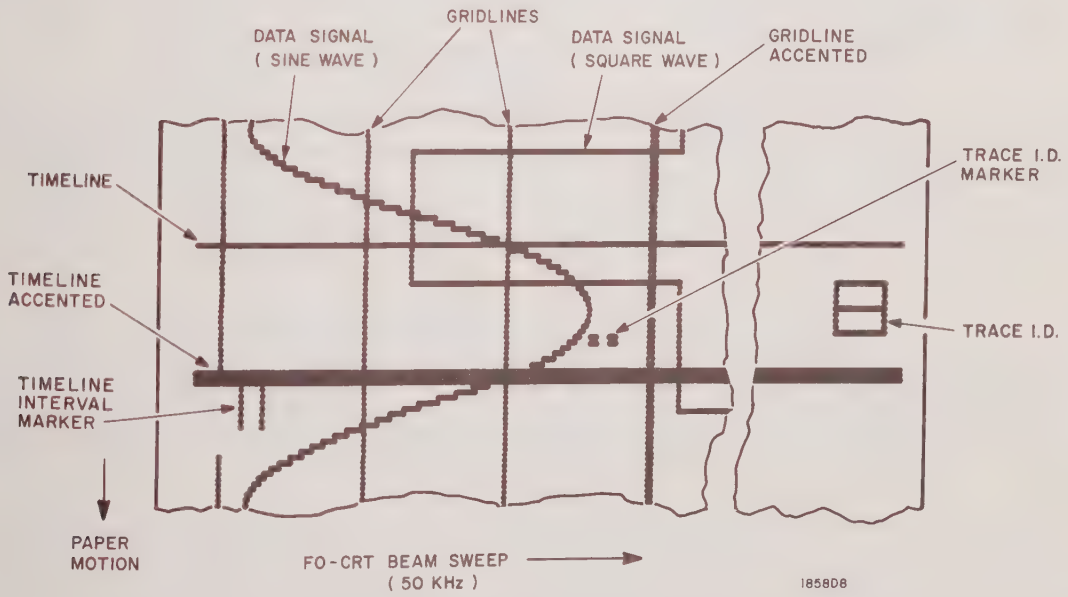


Figure 4-2. Magnified Section of a Model 1858 Recording

46.4 Vrms is taken from terminals 17 and 18 of power transformer A3T1 through F1 and connected to bridge rectifier A14CR1. The voltage is rectified to 55 Vdc, filtered by A3C4, and routed to series pass transistor A14Q1. Conduction through the series pass transistor is controlled by voltage regulator A3A6U1 through filter network A3A6C3-CR2-R3 and driver A3A6Q1.

Terminals 13 and 14 of A3T1 supply 20.4 Vrms to rectifier A3A6CR1 which provides 25 Vdc (filtered by A3A6C2) as the operating power for A3A6U1. Fuse F2 protects this section of the circuitry.

CAUTION

Any attempt to measure this voltage with a grounded meter will destroy the A3A6U1 regulator.

Potentiometer A3A6R8 adjusts the regulator for an A14Q1 output of 40 Vdc, and potentiometer A3A6R10 sets the foldback point for a current limit of 1 amp. A current limit amplifier within the A3A6U1 regulator allows the regulator to provide a constant output voltage while the output current can vary up to the 1 amp foldback limit. If a decreasing load resistance tends to draw current in excess of this limit through current sense resistor A3A6R1, the current limit amplifier begins to control the regulator output and reduces the output current in proportion to the load resistance. Should the load resistance go to zero, a small, short circuit current is allowed to continue to flow to sense the load condition. If the load returns to normal, the current limit amplifier senses this condition through R1 and the output of the regulator returns to normal.

The output of A14Q1 is taken through current sense resistor A3A6R1 and high frequency filtering network A3A6C6 and C7 to W1A1XA8 for distribution throughout the instrument.

C. 5 VDC REGULATED POWER

17.5 Vrms is taken from terminals 10 and 12 of A3T1 to full-wave rectifier A3CR1. The light in the POWER switch is connected across A3T1 terminals 12 and 11 (gnd) so that it does not light unless power is actually applied to the recorder. The rectified voltage is filtered by A3C1 and routed to series pass transistor A2A1Q2 and driver A2A1Q1 which is controlled by voltage regulator A3A6U2.

The operating voltage for the A3A6U2 regulator is taken from A14CR2 which is the rectifier for the ±12 Vdc supply. Potentiometer A3A6R14 adjusts the regulator for a A2A1Q2 output of 5.0 Vdc. A3A6U3 is used as a foldback current limiter amplifier for the 5V supply and produces foldback action as described for the 40V supply. Potentiometer A3A6R20 adjusts the offset of A3A6U3 for a short circuit output current from the

regulator of 1.2 amps maximum. Potentiometer A3A6R18 adjusts the foldback point for a current limit of 7.5 A. When the 5V output tends to exceed 7.5 A, the limit sense voltage across A3R1 becomes greater than the offset voltage developed by A3A6R16, R17, and R18 and the A3A6U3 output voltage goes negative and lowers the output of A3A6U2. The regulated 5 Vdc at A3R1 is distributed throughout the instrument and made available to the slide-in circuit card and plug-in module slots.

D. ±12 VDC REGULATORS

The ±12 Vdc regulators are contained on the A3A7 circuit card. The two circuits are similar to the 5 Vdc regulator discussed above.

The input voltage for both ±12V regulators is taken at terminals 7 and 9 of A3T1 as 35 Vrms and rectified by A14CR2 to ±16 Vdc. The center tap ground of this section of the transformer is protected by F3. The positive voltage is filtered by A3C2 and routed through series pass transistor A3Q1 which is controlled by regulator A3A7U1. Potentiometer A3A7R20 adjusts A3A7U1 for an A3Q1 output of 12 Vdc. A3A7U3 is the foldback current limiter for the positive voltage and the foldback point is adjuted by potentiometer A3A7R21 for an output current limit of 750 milliamps.

The negative voltage from A14CR2 is filtered by A3C3 and routed through series pass transistor A3Q2 which is controlled by regulator A3A7U2. Potentiometer A3A7R22 adjusts the regulator output, and foldback current limiter A3A7U4 is adjusted by A3A7R23 for an output current limit of 750 milliamps.

4-4. PAPER TRANSPORT SERVO

A. GENERAL

The paper transport servo system provides smooth motion of the recording paper across the FO-CRT at accurately controlled speeds from 0.1 to 120 inches per second. The servo is a pulse duration modulation system in which a constant voltage to the drive motor is switched on for a pulse period once every 180 μseconds. (approximately). The length of the pulse period is determined on the servo circuit card and allows sufficient current flow through the motor to drive the paper at the selected speed. A switch on the cradle door prevents paper servo action when the cradle is open.

The system also provides a record timer for the automatic control of recording duration and a rear panel BNC input connector to allow use of an external drive signal. The transport system includes RECORD SPEED IN/SEC, MULTIPLIER, and DRIVE pushbutton controls; the servo circuit card; the drive motor with belt driven rollers and tachometer; and the RECORD TIMER control.

B. SERVO CIRCUIT CARD (Figures 4-3 and 7-1)

The circuitry on the servo circuit card A1A1 is organized to provide the following functions; 6.2 voltage reference, pushbutton controlled resistance network, 6 kHz oscillator, output pulse logic and record timer logic.

Operational amplifier U6 and zener diode VR1 develop a stable 6.2 volt reference. The reference voltage is applied to the resistance network R22 - R35 through contacts on either the 16 IN/SEC pushbutton or the X10 MULTIPLIER pushbutton. (If both the 16 IN/SEC and X10 pushbutton are used together, the reference voltage to the other IN/SEC pushbuttons is disconnected to prevent overdriving the drive motor.)

Engaging one or more of the IN/SEC pushbuttons and one of the MULTIPLIER pushbuttons selects a path through the resistance network to the U5 operational amplifier for the 6.2V reference. (The slower the desired speed, the greater the resistance used to limit the current to U5.) The series - parallel organization of the network allows the use of combinations of the IN/SEC pushbuttons to select record speeds equal to the sum of the pushbuttons selected.

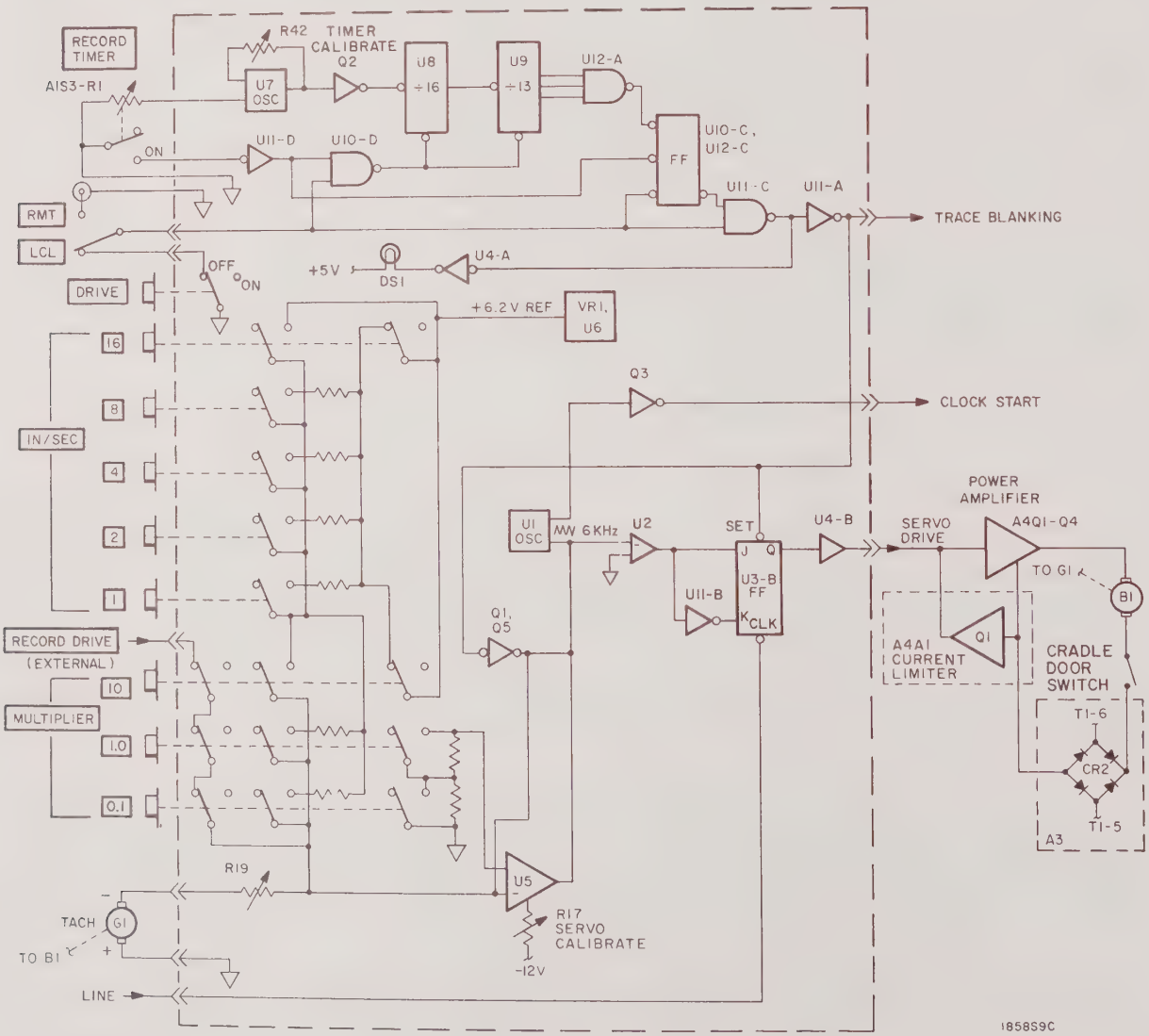


Figure 4-3. Servo Circuit Simplified Diagram A1A1

An external drive speed signal may be connected through the rear panel RECORD DRIVE connector. If an external signal is used, a positive voltage sufficient to supply an input current of 40μA per inch per second of desired record speed is required. Also, all of the IN/SEC and MULTIPLIER pushbuttons must be released to avoid mixing the internal reference and to connect the external signal to U5.

When the tachometer is turning, it generates a negative voltage which is connected through calibration potentiometer R19 to the summing point at U5 pin 2. The algebraic sum of the tachometer signal and the selected reference voltage at U5 pin 2 is amplified and inverted by U5. Potentiometer R17 balances the offset voltages to U5.

The U5 output is connected to U2 pin 3 where it is summed with the signal from the oscillator formed by U1. The oscillator output is a triangular wave at about 6 kHz. (The U1 output is buffered by Q3 and routed to the clock circuit card to start the clock oscillator.) The sum of the U5 and U1 signals is connected to the inverting input of comparator U2 and the logic output is applied to flip-flop U3-B directly at the J input pin 9 and through inverter U11-B to the K input at U3 pin 12.

At the U2 input, the summed reference and tachometer signals represent an underspeed condition by shifting the triangular wave in negative direction and a overspeed condition by shifting the wave in the positive direction. Shifting the dc portion of signals shifts the point of the triangular wave which crosses the threshold level required to trigger the U2 comparator. The U11-B inverter resets the flip-flop as soon as triangular wave falls below the threshold. Thus, changes in either the reference voltage or the tachometer signal control the duration of the U3 output pulse at pin 11.

The U3-B flip-flop action is also controlled by the line signal applied to the clock input at pin 6. The line signal is a short negative pulse that occurs at the beginning of the retrace portion of the CRT beam sweep cycle, U3-B flip-flop action is inhibited except during this pulse period. Thus, the output to drive motor is synchronized with the FO-CRT sweep to reduce interference.

The positive pulses out of U3 pin 11 are buffered by U4 and connected to the power amplifier composed of Q1 through Q4 on assembly A4. The power amplifier controls the current through the drive motor from rectifier A3CR2. The current limiter formed by A4A1Q1 and A4A1CR1 samples the current through each of the power amplifier transistors.

When the RECORD TIMER is not used, the input to U11-D is high and a low is connected to U10-D to disable the gate. The U11-D output low is also connected to the flip-flop composed of U10-C and U12-C. The other inputs to the flip-flop are both high. (The U12-A output is high because the timer is not on, and the DRIVE switch input goes high when the switch is locked in the "on" position.) The U11-D low sets the flip-flop output high. With both inputs to the U11-C gate high, the gate output is held low. The low output of U11-C allows U4-A to conduct and light the DRIVE switch lamp. The U11-C low

also keeps the U11-A output high to allow unblanking of the FO-CRT through the video amplifier and to keep Q1 and Q5 on to allow U5 to function.

When the DRIVE switch is released, a low triggers the U11-C gate and the video amplifier is disabled by the trace blanking low signal. Q1 and Q5 shut off to hold the U5 inverting input negative through CR2. The U5 output is also held negative through CR4 to establish an initial bias on capacitor C6 for quick starting at low servo speeds. The combined action shifts the signal to U2 far enough to keep the triangular wave from crossing the U2 threshold.

When the record timer is used, the RECORD TIMER switch connects a low to U11-D which prepares the U10-D to enable the U8 and U9 dividers when the DRIVE switch is engaged. The RECORD TIMER switch setting positions A1A3-R1 to determine the U7 oscillator frequency. (Potentiometer R42 provides for calibration of the oscillator) Q2 buffers the oscillator output and connects it to the input of a divide by 16 counter U8.

When the DRIVE switch is engaged U8 and U9 are enabled and the flip-flop output is high. (The high from the DRIVE switch does not affect the flip-flop.) The servo is enabled as described above and drives until U9 reaches the 13th count at which time the three inputs to U12-A are high. The U12-A output goes low resets the flip-flop and shuts down the servo by triggering U11-C. Releasing the DRIVE pushbutton sets the U10-C, U12-C flip-flop for the next record timer or manual operation.

NOTE

When the POWER switch is released, the decay of the operating voltages to U5 allows the oscillator frequency to pass through the the threshold of U2 causing the drive motor to operate until C4 is discharged and advancing the recording paper a short distance.

Elapsed time indicator M1 uses current applied through R54 to record the total number of operating hours of the FO-CRT to provide maintenance and warranty information.

Q4, W2, and cable II provide for a remote RECORD DRIVE switch.

4-5. TRACE DISPLAY SYSTEM

A. GENERAL

The trace display system processes all data and reference signals for presentation to the recording paper. The main components of the trace display system are the clock circuit card, the video amplifier, and the high voltage assembly. The clock circuit generates the timing signals used to synchronize the data conditioning plug-in modules and the reference line generating circuits with the CRT beam sweep. The video

amplifier accepts and amplifies all data and reference display signals. The high voltage assembly transmits the amplified video signal for control of the CRT.

B. CLOCK CIRCUIT CARD (Figures 4-4 and 7-2)

The clock circuit card is organized to provide the following five functions: clock timing, ramp amplification, vertical oscillator, horizontal oscillator, and paper meter drive.

The clock timing circuits are activated by the clock start signal from the servo circuit card. The first negative-going pulse on the clock start line triggers U14-A to go high to U7 pin 5. The U7 one shot produces a low at its $\overline{Q}$ output for about 13μsec. At the end of the U7 period, the positive going transition triggers the U6 one shot. The U6 period is about 7μsec. When U6 times out, its $\overline{Q}$ output goes low and re-triggers the U7 one shot. (While U6 and U7 are running, the clock start signal is inhibited by U14-A.) The combined period of U7 and U6 is adjusted by potentiometer R51 to 20μsec, $\pm$0.2μsec. The resulting signal at the $\overline{Q}$ output U7 pin 1 is the preline signal which is routed to the high voltage assembly for development of the horizontal sweep. Overall, the preline signal slightly leads the other timing signal to compensate for time delays in the horizontal sweep circuit in the high voltage assembly.

The ramp amplifier senses the horizontal deflection signal in the high voltage assembly and develops the ramp signal to synchronize the display data and reference signals to the CRT beam position. The ramp sense input to the clock card is transformer coupled from the high voltage assembly. As the flow of current in the ramp sense line starts, U1, Q4, Q5, and Q6 function as a single stage high output amplifier. The resistor-diode network, CR2 through CR7 and R7 through R18, establish a non-linear feedback for the ramp amplifier to compensate for the non-linear relationship between deflection current and FO-CRT beam position. The output of the amplifier is routed to the plug-in modules, the gridline generator, and the trace identifier circuit to provide CRT beam position information. R1 adjusts the ramp amplitude and R82 adjusts the U1 offset to center the ramp in its voltage range.

The ramp signal is also used on the clock card to trigger the clock signal generator and the line signal generator. The ramp signal is connected to the U15 comparator which is offset to react only at the lower extreme (-4V) of the ramp signal. The U15 output is a negative going pulse that occurs when the ramp signal has returned the CRT beam to the beginning of the sweep. The U15 output is buffered, inverted, and applied to the clock input of U10-B and the clock input of U10-A. U10-B has no other input signals and thus functions to divide the input frequency in half. The U10-B $\overline{Q}$ output is buffered and shaped by Q8 and routed to the plug-in modules as the clock signal to enable the voltage-to-time converters to operate.

The ramp signal is also connected to the U16 comparator. The input to U16 is offset to allow the signal to cross the comparator threshold only at the upper extreme (+4V) of the ramp signal. Thus, the U16 output is a positive-going pulse that starts at the completion of the useful CRT beam sweep. The comparator output is inverted by buffer U13-D and connected to the U10-A set input, the U17 one shot, and the U14-C gate.

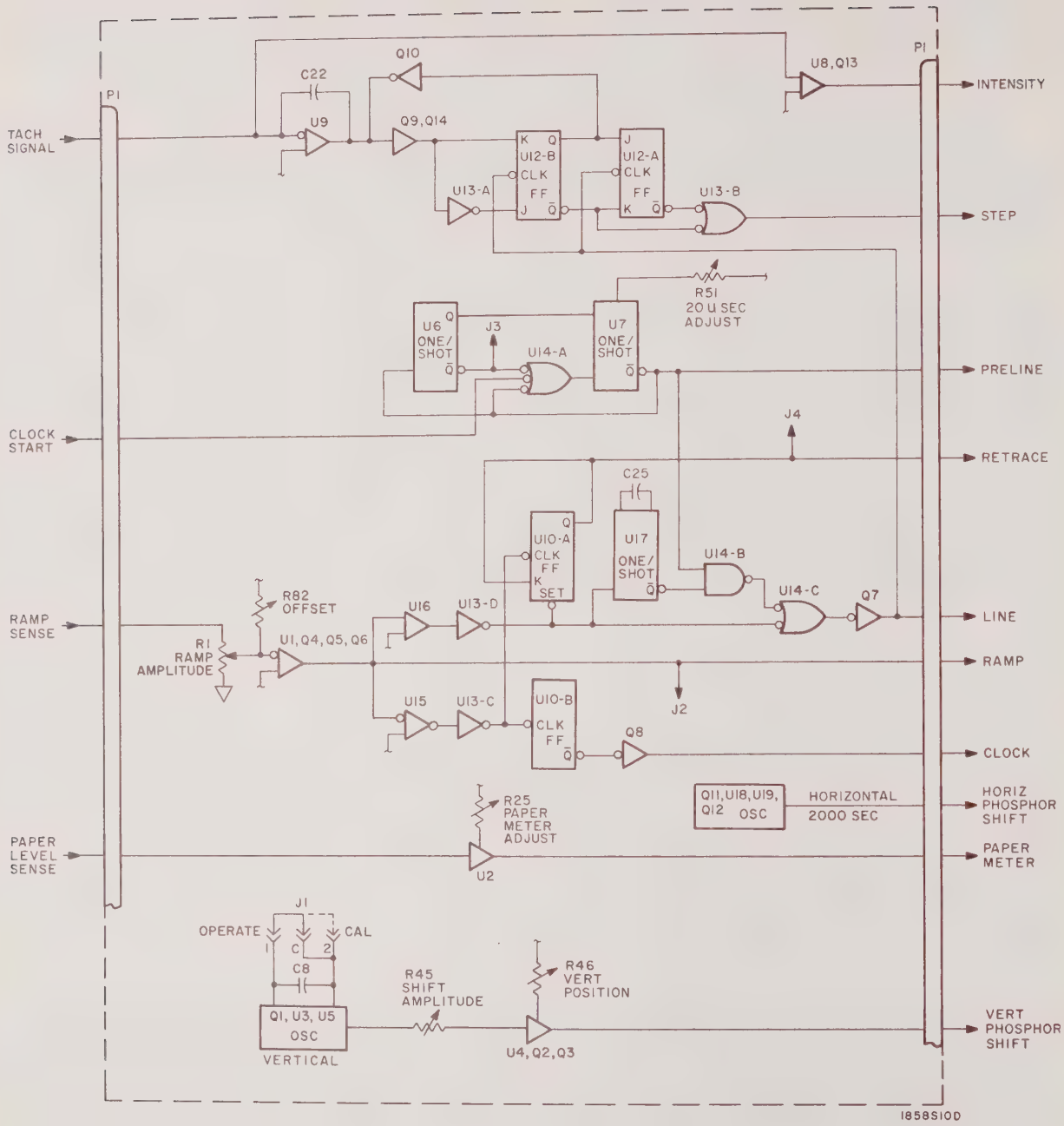


Figure 4-4. Clock Circuit Simplified Diagram A3A3

During normal operation, U17 is held in the set condition, (because the pulse is too short to allow the one shot to timeout) which inturn disables the U14-B gate. Thus, the U13-D output triggers the U14-C gate and the output is buffered and inverted by Q7 as the line signal.

However, during initial turn-on of the unit, the ramp does not immediately build up far enough to trigger the U16 comparator. U17 is allowed sufficient time to timeout to enable the U14-B gate to pass pulses from the U7 flip-flop. The U7 signal simulates the line signal which is required by the servo circuitry to maintain control of the drive motor.

The U10-A flip-flop functions as the retrace signal generator. The U13-D negative going output at the U10-A preset input sets the U10-A output high as the CRT sweep ends. The U13-C positive going output at the U10-A clock input resets the U10-A output low as the CRT begins a new sweep. The retrace signal is routed to the servo, video, gridline, and optional timeline circuit cards for synchronization.

The input to the step generator is the tachometer signal which is a negative voltage directly proportional to the paper transport servo speed. The tach signal is connected to the integrating amplifier U9 which charges C22. During the time that it takes C22 to charge (which is equal to a paper travel of 1/16 of an inch), both of the U12 flip-flops stay in the reset ($\overline{Q}$ high) condition. As C22 is charged, Q9 and Q14 turn on, the input to U12-B J goes high and U12-B K low. The next line pulse, allows U12-B to change state. The low now at U12-B $\overline{Q}$ output triggers the U13-B gate. The high which is now on the U12-B Q output turns on Q10 which allows C22 to discharge and shuts off Q9 and Q14. When Q14 goes off, the input to U12-B J input goes low again. The next line pulse allows the U12-A flip-flop to assume the set condition in response to the present U12-B outputs while simultaneously allowing U12-B to change state in opposite direction. U12-A Q output is now low holding the U13-B output high. C22 is still uncharged at the occurrence of the line pulse so U12-B does not change state, but U12-A does change in response to the previous U12-B change. Both $\overline{Q}$ outputs are now high again and the U13-B pulse ends.

The vertical shift circuit develops signals to produce a gradual change in the vertical position of the CRT beam to increase the phosphor life. The vertical oscillator is a triangular wave generator composed of U3, Q1, U5. Initial random currents start U3 driving toward one of its extreme excursions. This action supplies current through R39 to C7 and Q1. As C7 reaches maximum charge, Q1 and U5 drive U3 in the opposite direction. U4, Q2, and Q3 form a power amplifier for the vertical oscillator. R45 adjusts the vertical shift amplitude for a span of about 0.20 inch. R46 adjusts the offset to center the area of the deflection within the area of the faceplate. J1 is positioned C to 1 for normal operation. This produces a long period waveform to slowly move the CRT trace over the useful phosphor area to prolong phosphor life without noticeable effect on the recording. In the C to 2 position the frequency of the vertical sweep is speeded up to allow calibration. The output of the vertical shift circuit is connected to the high voltage assembly directly to the vertical deflection yoke.

Q11, U18, U19, and Q12 form the horizontal oscillator. The oscillator is similar, both in form and function, to the vertical oscillator just described. C27 sets a fixed long period of 2000 seconds for the oscillator. The need for a separate power amplifier and adjustment controls is eliminated by summing the signal directly with the ramp signal (horizontal sweep) in the high voltage assembly.

The paper meter amplifier circuit consists of a single driver amplifier U2. The position of the paper supply sensor arm determines the portion of the positive 12 Vdc applied at the sensor arm resistor offsetting the -12 Vdc applied at R29. The sensor arm may be repositioned on its resistor to calibrate for the Empty reading. U2 amplifies and inverts the signal to drive the PAPER indicator on the front panel. R25 adjusts the feedback around the amplifier and thereby controls the gain of the amplifier.

An automatic intensity control circuit composed of U8 and Q13 is located on the clock circuit card. The tachometer signal is sampled through R49 and connected to the inverting input of U8. When the signal indicates a servo speed of 1 IN/SEC or less, U8 allows Q13 to conduct and draw current from the base of A1Q33 (on the video amplifier) to reduce the dot intensity for low speed operation to conserve CRT phosphor life.

C. VIDEO AMPLIFIER CIRCUIT CARD (Figure 4-5 and 7-3)

The video amplifier circuit card conditions all signals displayed on the CRT. The input signals to the video card are presented in their dot (static or slow moving) and dash (fast moving) component form as developed by the plug-in modules or reference generator circuits. The video card contains individual input conditioning circuits for each dot signal channel; the dot gate and amplifier; the video output amplifier; and control logic to inhibit signal display on the edge of the CRT or during the retrace period.

The dot signals from the 18 data channel plug-in positions and the accented gridline channel are routed to individual input circuits shown on the schematic as Circuit 1. The presence of a dot signal is a transition from low to high on the A input to the gate. Assuming the signal is not arriving during the retrace period, the B input to the gate is already high so that the gate output immediately goes to a low. The transition to low is coupled through the capacitor in the C1 position as a pulse to the base of the transistor in the Q1 position. The width of the pulse is set by the combination of the capacitor and the resistor in the R23 position and determines the "on" time for the output transistor thereby controlling the width of a static trace on the CRT. For the channels using Circuit 1, there is only one input per channel during each sweep cycle. This allows the capacitor time to discharge relatively slowly through the resistor in the R1 position after the A input returns to a low.

Dot input Circuits 2, 3, and 4 on the schematic use additional circuitry to shorten the recovery time of the capacitor to increase the repitition rate of the circuit. Circuit 2, which is used for the trace identifier and timeline marker dot signals (channel 20), uses the capacitor in the C23 position to couple a pulse from the A input (as it returns to a low) to the transistor in the Q23 position. Q23 conducts for the duration of the pulse

and allows the capacitor in the C20 position to rapidly discharge through the low value resistor in the R20 position. Dot input Circuit 3, which is used for the normal gridline signal (channel 22), adds a variable capacitor C54 to allow adjustment of the normal gridline trace width. Circuit 4 (channel 21) is the same as circuit 2 except for an additional inverter U6 to compensate for inverted input signal.

All of the dot input circuits are connected to a diode gate composed of CR26, CR27, CR28, and CR29. CR30 provides a spare connection to the dot gate through connector C on the card. If any one or more of the dot circuit outputs goes low, the low is coupled to the base of Q26. The collector of Q26 is controlled by the inhibit circuit discussed later. The output of Q26 is connected to a complementary amplifier composed of Q27 and Q28. The complementary amplifier drives Q29 into conduction when a dot is present. The amplitude of the Q29 output is controlled by Q33 and potentiometer R74. The adjustment of R74 sets the intensity of the dot presentation on the CRT. The Q29 output is connected through CR44, C27, and CR47, to the combined video amplifier Q31.

All dash signals are connected to the video circuit card on the dash common line at P1 pins 28 and 58. In the absence of a dash input signal the base of Q30 is held at about -1 Vdc by the conduction from the -6 Vdc (established by VR1) through R57, CR38, and R60 to +5 Vdc. When a dash signal from any one or more of the plug-in modules (or from the timeline or trace identifier options) goes high, the voltage base of Q30 goes

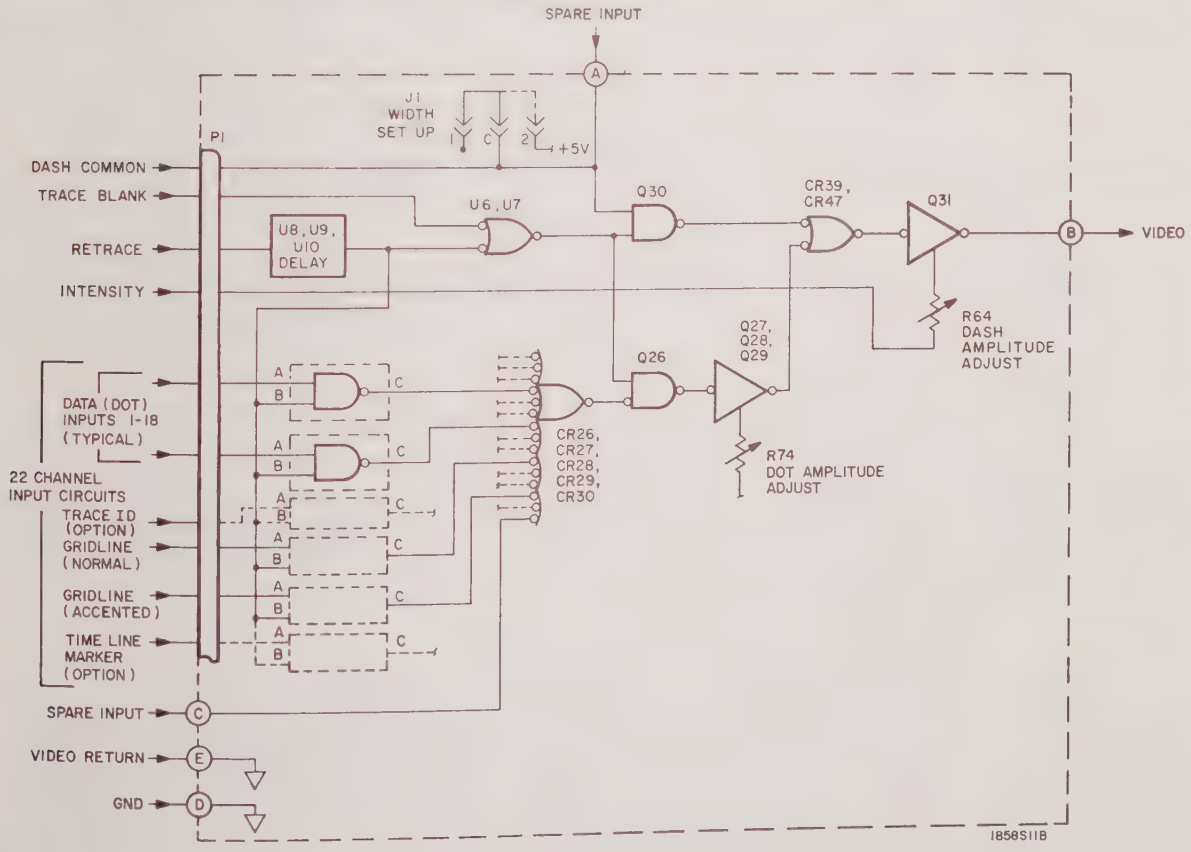


Figure 4-5. Video Amplifier Simplified Diagram A3A1

positive. Q30 conducts and the signal is coupled through CR39 to Q31 as a low. The base of Q30 can also be controlled by the inhibit circuit through U7 pin 2 as discussed later.

The C to 2 position of jumper J1 is used for calibration. The 5 Vdc through the jumper simulates a continuous dash signal which is presented on the CRT for width adjustment.

CAUTION

Jumper J1 should not be allowed to remain in the C to 2 position any longer than is absolutely required by the calibration procedure or the CRT life may be reduced.

The combined video amplifier Q31 accepts the dash signal through CR39 and the dot signal through CR47. If either signal goes low, the output through connector B to the high voltage assembly goes low. Q31 is used in an active pull-up configuration to improve the rise time of the circuit. R76, CR49, and CR50 are used to arrest surges which might occur in the event of a high voltage failure. Potentiometer R64 is used to adjust the amplitude of the dash signals by adjusting the reference voltage through Q32 which adjusts the level of Q31 in its high state.

The inhibit circuit is used to prevent unblanking the CRT during the retrace portion of the sweep cycle and to eliminate extraneous signals which may be produced when a plug-in module is in an overscale condition. When the retrace portion of the sweep cycle begins, a high from the clock circuit card appears at A1P1 pin 29. This high is connected to U10 pin 9 and through inverter U8 pins 1 and 2 as a low to U10 pins 7 and 12. These inputs set the U10 flip-flop for a high at U10 pin 11. The high is inverted by the U8 buffer-inverters at U8 pins 9, 11, and 13. The lows out of the U8 buffers are connected to the dot input circuits to inhibit all dot signals.

The low from U8 pin 8 is also connected to the U6 gate at U6 pin 12. (The U6 gate also accepts the trace blank signal from the servo circuit card A1A1. The trace blank signal is low only when the DRIVE pushbutton is not engaged or a record timer period has ended.) The high at U6 pin 11 is coupled through two U7 inverter stages to the two buffer-inverters at U7 pins 1 and 13. A low output at U7 pin 2 and 12 inhibits the dash signal at the base of Q30 and the dot signal at the collector of Q26.

At the beginning of the sweep cycle, the incoming signal prepares to reset the U10 flip-flop by going low at U10 pin 9 and through inverter U8 pin 1 to 2 high at U10 pins 7 and 12. The flip-flop does not reset immediately because the high at U8 pin 2 also triggers the one-shot at U9 pin 5. U9 pin 6 holds the U10 clock input at U10 pin 6 high for the duration of the one-shot period set by R72 and C51. The U10 flip-flop cannot reset until U9 pin 6 goes low. This delay prevents the presentation of erroneous dot signals from the plug-in modules which can be caused by overscale conditions.

When the flip-flop does reset and the U8 buffer-inverters go high at U8 pin 8, 10, and 12 to dot input circuits at the B inputs, the dot circuits are conditioned to accept any dot signal. However, the dot input circuit for any unused plug-in position also has a high (an open) at its unconnected A input. This condition generates a false dot signal at the beginning of the sweep. To prevent presentation of the false signal, the R59-C50 network at U7 pin 6 is used to introduce a slight additional delay in the release of the inhibit signals to Q30 and Q26.

D. HIGH VOLTAGE ASSEMBLY (Figures 4-6 and 7-4)

The high voltage assembly accepts the conditioned video input, the deflection shift signals, and the sweep generating and timing signals. From these signals, the assembly develops the high voltage, the deflection signals, and the CRT control voltages.

The preline signal from the clock circuit card is connected to the high voltage assembly at A3A11 pin 14 and is routed through A3A11U2 to the base of the heat-sink mounted A3A12A1Q1. The A3A12A1Q1 collector drives the base of A3A12A1Q2 through A3A11CR1 and A3A11C2. A3A11Q1 functions as an active pull-up to recharge

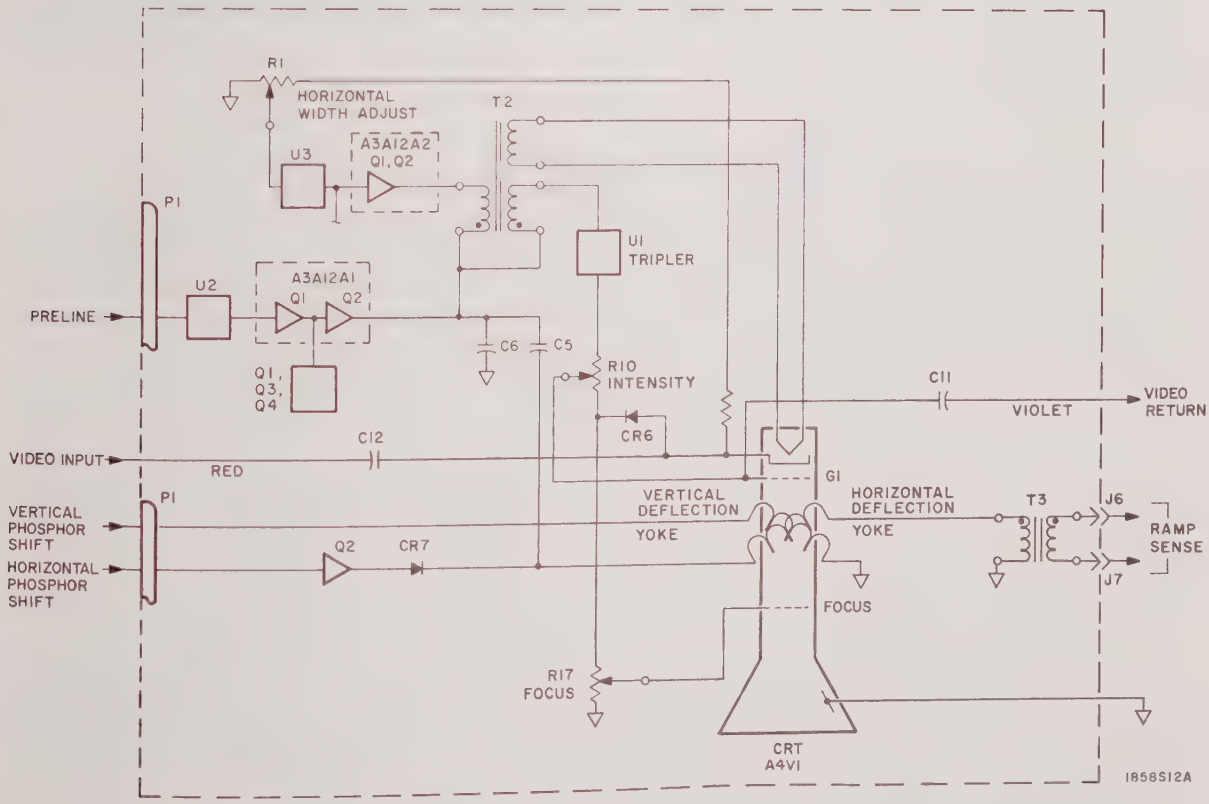


Figure 4-6. High Voltage Assembly Simplified Diagram

A3A11C2. A3A11Q3 provides a switched constant current source for the A3A12Q2 base. A3A11Q4 rapidly cuts off A3A11Q3 and thus A3A12A1Q2 at the end of the pulse.

The A3A12A1Q2 collector directly drives the T2 primary. While Q2 is conducting, the current through the T2 primary (functioning as a fixed inductor) and the horizontal deflection coil rises linearly. Then A3A12A1Q2 shuts off, the T2 primary, deflection coil, and A3A11C6 act as a parallel tuned network. While the inductor field collapses, C6 accepts the charge. As the C6 charge builds, the apparent voltage rapidly rises to about 230V and then falls. As the voltage on the A3A12A2CR1 collector goes through 0V in the negative direction after the transistor is shut off, A3A12A1CR1 starts to conduct and detunes the network through the T2 primary and the horizontal deflection coil. The current through this network which had reversed when A3A12A1Q2 shut off, changes direction again and rises in a linear pattern. Thus the signal through the T2 primary becomes a series of pulses occurring after the preline signal. The magnified pulses are coupled by the T2 secondary to the U1 tripler circuit. Due to the transformer winding ratio the input to the tripler is about 3300V. The tripler output is approximately -10,000V. A3A11R10-R11-R12-R17-R18-R20 form a divider network selecting the appropriate voltages for the CRT electrodes. R10 is the potentiometer allowing adjustment of the intensity and R17 is the potentiometer controlling the focus electrode.

The conditioned video signal is coupled through A3A11A1L3 and A3A11C12 to the summing junction with the high voltage at A3A11CR6 and the cathode of the CRT. Surge arrestors E1 and E2 protect the video amplifier. A3A11CR6 is a recovery diode which allows A3A11C12 to maintain its charge.

Capacitor A3A11C5 couples the ac current flow signal from the C6-T2 primary network to the summing junction with the horizontal shift signal and the deflection yoke. The horizontal shift signal is a low level (0V to -7V), long period (2000 seconds) oscillation developed on the clock circuit card and connected through A2A11 pin 3 to constant current amplifier A3A11Q2 and CR7 to the summing junction. The combined signals are applied directly to the horizontal deflection yoke to produce the 50 kHz sweep of the CRT beam. Transformer T3 allows the sensing of the horizontal deflection signal for development of the ramp signal (on the clock card) to synchronize display signals with the actual beam position.

High voltage regulation is achieved by A3A11U3 sensing the voltage on the CRT cathode through R16, potentiometer R1, and R2. The potentiometer controls U3. The U3 output through A3A11Q5 and A3A12A2Q1 to A3A12A2Q2 controls the source voltage available to the T2 primary. In this manner, A3A11R1 controls the amplitude of the high voltage and allows adjustment of width of the FO-CRT beam sweep.

The vertical shift signal from the clock circuit card is applied directly to the vertical deflection yoke. The shift signal is a low level, long period oscillation which produces a slight up-and-down shift of the CRT beam writing area to extend phosphor life.

4-6. REFERENCE LINE GENERATORS

Three circuit cards generate display reference signals. These are the gridline generator, the optional timeline generator, and the optional trace identifier. These signals are presented on the record to aid in the analysis of the recorded data signals. The gridline generator provides reference lines parallel to the length of the record against which the amplitude of the data signals may be more accurately measured than by use of a scale. The optional timeline generator provides a selectable or automatic system of accurately spaced lines perpendicular to the paper travel against which the duration of data signals may be measured. The trace identifier provides an automatic and permanent system of identifying the various data signal traces which is particularly helpful when the 18 channel system capability is utilized and when the Model 1870 Amplifier is used to expand system capacity.

A. GRIDLINE GENERATOR A3A4 (Figures 4-7 and 7-5)

The gridline generator is composed of a -6.50V reference supply, a precision current ladder network and controlling logic, a comparator, a fifth gridline accent logic, and gridline allow logic.

Operational amplifier U11 accepts its supply voltage from the 12 Vdc through R21 at the inverting input. Feedback to the non-inverting input of the amplifier is referenced to a fraction of the output through R19 and potentiometer R20 which allows adjustment of the reference supply to -6.50V $\pm$50 mV. VR1 establishes a constant differential between the amplifier output and the inverting input to produce automatic correction of output variations.

The U12 comparator samples a combination of the incoming ramp signal, a fixed offset voltage, and the current ladder. The ramp signal (indicating CRT beam position) is applied to the gridline generator circuit card at pin 26 and routed through calibration potentiometer R31 to the summing junction at R28 and U12 pin 3. U13 develops a stable positive voltage from the -6.50V reference and applies an offset current through the potentiometer R24 to the summing junction. The offset is adjusted to produce a -0.25V input to U12 at the end of the retrace period of the ramp signal. At the end of retrace period, the input at U12 pin 2 is held at 0V by R32 and R33. (CR22 and CR23 are used in combination for temperature compensation.) The U12 output is at 5.5V to charge C4. The retrace signal at card connector pins 28 and 58 buffered and inverted by U8-A clears all flip-flops on the circuit card.

As the ramp begins to sweep positive, the summed input at U12 pin 3 exceeds 0V and triggers the comparator to its low output. (The charge on C4 back biases CR23 lowering the comparator input at U12 pin 2 to keep the comparator triggered until C4 discharges.) During the pulse held by C4, the U12 output low triggers both the current ladder logic and the output logic.

The current ladder logic is a binary counter made up of flip-flops and gate inverter combinations which form a divide-by-64 counter. Flip-flop U1-A is the first stage in the counter and on the first pulse (because its J and K inputs are held high)

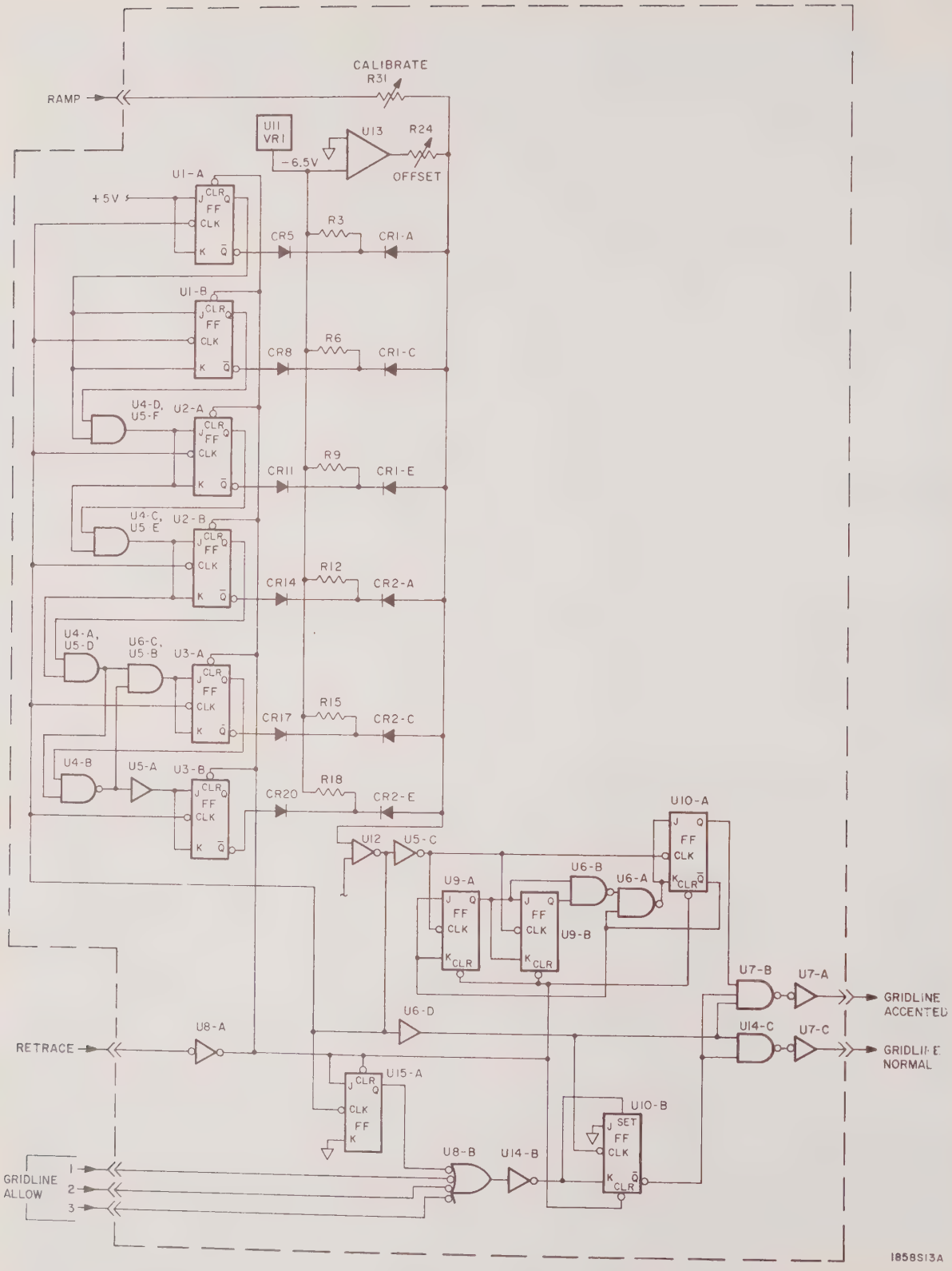


Figure 4-7. Gridline Generator Simplified Diagram A3A4

from U12, the U1-A $\overline{Q}$ output goes low. This low through forward biased CR3 and CR4 establishes a reverse bias condition on CR5. When CR5 shuts off, CR1-A becomes forward biased and establishes a current path from the summing junction through R3. R3 is connected to a voltage which is one diode voltage drop lower than the -6.50V reference. This lowers the voltage at the summing junction below the U12 comparator trigger level and the U12 output switches high. CR1-A is temperature compensated by CR1-B.

When the ramp signal pulls the summing junction above the comparator threshold again, the second comparator output pulse changes the U1-A state back biasing CR1-A. The U1-A output is also connected to U1-B J and K inputs and U1-B changes state forward biasing CR1-C. The network controlled by U1-B functions in the same manner as the network just described except that R6 and R5 are half the value of R3 and R2. Thus, the current flow in the R6 network is double the current flow in R3. The additional current flow pulls the summing junction (despite the advancing ramp voltage) back below the original U12 threshold. On the next U12 pulse both U1-A and U1-B set their networks on, and the current flow through R3 and R6 are added to pull the summing junction down. This process continues with U2 and U3 flip-flops allowing the maximum possible count to go to 63.

The U12 comparator output pulses connected to the output logic trigger the normal gridline output at U6-D and the fifth gridline accent logic at U5-C. Assuming the gridline allow conditions are met, the U14-C gate will trigger on each comparator output and the signal, inverted by U7-C, is routed to the video amplifier to print a dot on the record.

The fifth line accented network functions as a divide-by-five counter. Because the comparator signal is inverted by U5-C, the counter responds on the (positive-going) edge of the U12 output. On the first U12 pulse, the U9-A Q output goes high. (The U9-A J and K inputs are held high by U10-A $\overline{Q}$ until the fifth count.) The next pulse lets U9-B Q go high and U9-A return low again. The third pulse sends U9-A high and U9-B low, but during the transition both inputs to U6-B are high. The U6-B output goes low to U6-A which goes high to enable U10-A to clock on the next pulse. The fourth pulse sets U10-A Q output high and U9-A and B low. Because the circuit is operating on the end of the comparator pulses the U10-A high Q output does not arrive in time to fulfill the U7-B input requirements on the fourth pulse, but remains high to end of the fifth pulse. So, as the fifth pulse through U6-D goes high, the U7-B inputs are all high (assuming the gridline allow logic conditions are met) and U7-B goes low to trigger U7-A output high to the video amplifier to produce an accented gridline. The output of U10-A change-of-state delay also inhibits the triggering of the U9 flip-flops during the fifth pulse. Because the gridline allow logic discussed below does not allow the first comparator pulse to produce a normal gridline, the first accented gridline appears as the fourth gridline.

The gridline allow logic accepts three inputs; gridline allow 1 is from the optional timeline circuit and inhibits the gridline signal only while interval markers are being printed. Gridline allow 2 is from the optional trace identifier and inhibits gridlines only during the time that trace identifier signals are being displayed. Gridline allow 3 is from the GRIDLINE switch and inhibits the gridline signal whenever the switch is in the OFF position or in the INTerrupteD position when the optional timeline generator

produces the gridline interrupt signal. Unless one of these situations exists, these three inputs are held high through pull up resistors R39, R40, and R41. U15-A controls the remaining input to the U8-B gate. During retrace, U15-A is cleared and the U15-A J input is low. The first U12 comparator output clocks the U15-A Q output to a high and holds it high until the next retrace pulse occurs. With all inputs high, the output of U8-B is low, and the U14-B output goes to a high to U10-B input K. At the end of inverted comparator output through U6-D, the U10-B flip-flop $\overline{Q}$ output is clocked high. The high is routed to enable both U14-C and U7-B gates. Since U10-B is clocked on the end of comparator pulse, the enable high to U14-C does not arrive in time to permit the first comparator output through U6-D to print a gridline, but unless one of the gridline allow inputs goes low, all subsequent pulses do produce gridlines until the retrace period clears the U15-A and U10-B flip-flops.

B. TIMELINE GENERATOR A3A5 (Figures 4-8 and 7-6)

The optional timeline generator develops the timeline signals at switch selected or automatically selected intervals with the tenth line accented and internal period identified. The timeline generator also produces the gridline inhibit signals for use when GRIDLINE INTerrupteD is selected. The timeline generator circuitry includes a 100 kHz oscillator and countdown network, interval select logic, tenth line accent logic, interval identification logic, and gridline interrupt logic.

The 100 kHz oscillator is composed of Q1, Q2, and Q3 and control crystal Y1. The oscillator output is applied to two successive divide-by-10 stages U17 and U20. The 1 kHz output of U20 is applied to gate U16-A. The other U16-A input is high except when the TIMELINE switch is in the EXTernal position. Thus, unless external timelines are selected, U16-A passes the 1 kHz signal to countdown network through gates U7-A, U7-D, U12-A, and U12-D.

These gates are controlled by the interval select logic. When a particular interval, for instance 0.1SEC, is selected on the TIMELINE switch a low is connected directly to one of the following gates; U5-A, U5-B, U5-C, or U6-C. In this case, the low from the switch is connected to U5-B which goes high to U12-D and U4 pins 6 and 7. The high inhibits U4 and sets its output high to U12-B. The gate output high to U12-D allows the 1 kHz signal through to U12-B and with the high from U4, U12-B passes the signal to U8. U8 has a low on pin 7 and 6 because all inputs to U5-C are high. The low allows U8 to divide the 1 kHz by 10. The U5-C low also hold the U7-A output high, which in turn allows U7-C to pass the U8 output to U13. U13 divides the U8 output by 10. Because the U5-A output is low, U12-A allows the signal to pass through U25-C to shift register U24.

U25-C would pass an external timeline signal if the TIMELINE switch is placed in EXTernal and the signal applied through the rear panel connector to U19-B. The U19-B one shot is used to shape the external signal. U23-B holds the one shot output high unless EXT is selected at the switch.

The automatic interval selection signal comes through the engaged speed selection IN/SEC and MULTIPLIER pushbuttons when the TIMELINE switch is set to AUTOmatic. For instance, if the switch is set to AUTO and the MULTIPLIER X0.1

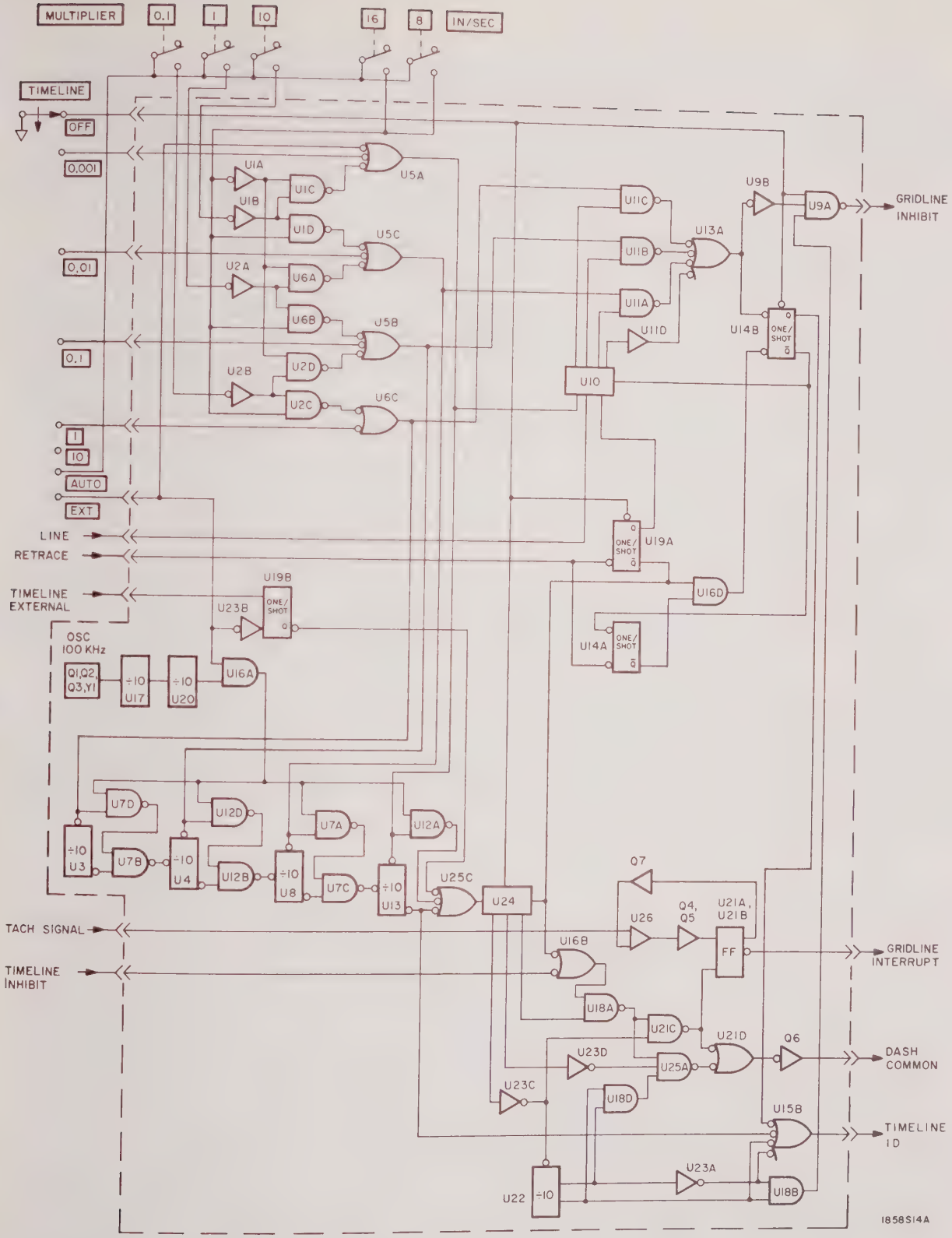


Figure 4-8. Timeline Generator A3A5 (Option) Functional Diagram

and 8 IN/SEC are engaged, the low from the MULTIPLIER switch is connected through the X0.1 pushbutton to U2-B; and the low is also connected through the 8 IN/SEC pushbutton to U1-A, U1-D, U6-B, and U2-C. The inverted U2-B output is routed to gates U2-D and U2-C. The U2-C gate is inhibited by the low direct from the 8 IN/SEC pushbutton. The U2-D gate receives the inverted output of U1-A. Thus the U2-D gate output goes low and U5-B selects a 0.1 SEC timeline interval for the countdown network. If the selected IN/SEC pushbutton(s) had not included either 16 or 8, the high on the line from these pushbuttons would enable U2-C and thus selected the 1 SEC interval timeline.

The U24 shift register is clocked by the U19-A one-shot which receives the retrace signal. U19-A produces a short inhibiting pulse at the end of the retrace pulse. The length of the inhibit pulse is set by C4. When the inhibit pulse ends, the countdown network pulse is routed to U18-A. U16-B enables U18-A after the inhibit pulse ends unless a timeline inhibit signal from the optional trace identifier is present. When U18-A triggers high, it sets the U21-C output low which triggers gate U21-D and buffer Q6 emitter to a high to the video amplifier to produce a timeline. The next retrace pulse causes the U24 shift register to present a pulse to U23-C. U23-C inverts the pulse and the output low to U21-C ends the normal timeline signal. In this manner, a normal timeline is limited to one sweep period.

U22 also accepts the U23-C output low and divides the frequency by 10. When the tenth normal timeline ends, both U22 outputs pins 12 and 11 are high and U25-A is triggered high through U18-D. The U25-A output continues the timeline output signal through the next two sweeps. The retrace pulse at the end of the second additional sweep shifts the pulse to U23-D which inverts the pulse and ends the accented timeline output. The shift register continues its function with each retrace pulse so that its outputs all return to low after five sweeps when the countdown network output goes to the low half of its cycle.

The timeline identification logic produces a group of vertical marks (one half the distance between timelines) at the left edge of the record to indicate the interval of the timelines being printed. The timeline identification logic is triggered by the end of retrace pulse which sets the $\overline{Q}$ output of both the U19-A and U14-A one-shots low to U16-D. (The U10 shift register is cleared by the line signal at the end of previous sweep. The U19A change of state sets the first U10 register.) The U16D output is low until U19-A times out. When U16-D goes high, U14-B is triggered, and at the end of the U14-B timeout it triggers U14-A and the U10 shift register. The U10 register shifts the pulse to the output of U11-A. If the 0.01 SEC interval is selected, the input to U11-A from the interval select is a high. As the pulse from U10 arrives, the U11-A output goes low sending the U15-A gate output high and inhibiting the U14-B one-shot after one output pulse. An interval selection of 0.1 SEC would allow two U14-B pulses through. The U14-B pulse has fulfilled the U15-B input requirements. (It must be the 9th U22 count for both the direct U22 input to 15-B and the input inverted by U23-A to be high to U15-B. The U13 output to U15-B must also be high.) These conditions continue to exist for one half the interval cycle as determined by the U13 pin 12 output. During this time, the U15-B output is printed on each sweep. Thus, the recording builds up a vertical line for each U14-B output pulse allowed through by U10.

U18-B routes the indication of the 9th timeline interval period to the U9-A gate to generate the gridline inhibit signal. The input to U9-A pin 3 is high at any time the TIMELINE switch is not OFF. The U9-B input to U9-A is low except during the time U15-A allows the U14 one shots to operate. Thus, the U9-A output inhibits gridlines only in the immediate area of the timeline identifier marker. This signal is connected to the gridline circuit card at gridline allow 2.

Operational amplifier U26 samples the tachometer output. When the C3 capacitor builds up a charge through R9 equal to the current generated by the tachometer during 1/16 inch of paper travel, CR2 becomes forward biased turning on Q4 and Q5. The low output of Q5 sets the U21-A and B flip-flop for a low at U21-A pin 3. This low is routed to the gridline circuit card on gridline allow 3. As a low, it inhibits the gridlines during gridline interrupt mode operation. The U21-C output is routed to reset the flip-flop at the end of the timeline print period. When the flip-flop is reset, Q7 turns on and allows C3 to discharge.

C. 32-CHANNEL TRACE IDENTIFIER A3A2 (Figures 4-9 and 7-7)

The optional 32-channel trace identifier circuit card detects the presence of each data input channel and the position of its recorded trace. The circuitry develops signals to mark the trace position and print the identifying channel number along the right edge of the recording. The circuit card presents its output signals in the dot/dash component form to the video amplifier for display by the CRT.

Jumper J1 selects either 18-channel or 32-channel operation. In the C to 1 position, only active data channels processed by modules located within the Model 1858 are identified. The C to 2 position adds the ability to identify active data channels (19 through 32) processed by modules located in the Model 1870 Amplifier Housing. Provisions for using the Model 1870 Amplifier Housing are not included on Underwriter's Laboratories listed units.

NOTE

Selecting the 32-channel mode when the Model 1870 Amplifier Housing is not connected to the Model 1858 results in the display of numbers 20 through 39 along the right side of the record. Thus, when the desired operational setup does not require the use of the Model 1870, position the jumper for the 18-channel mode to achieve the more frequent identification of the channels actually in use.

When the paper drive is running, a step signal is generated on the clock circuit card. The step signal is a logic one (high) which lasts for two sweeps of the CRT beam and occurs one for each 1/16 inch of paper travel.

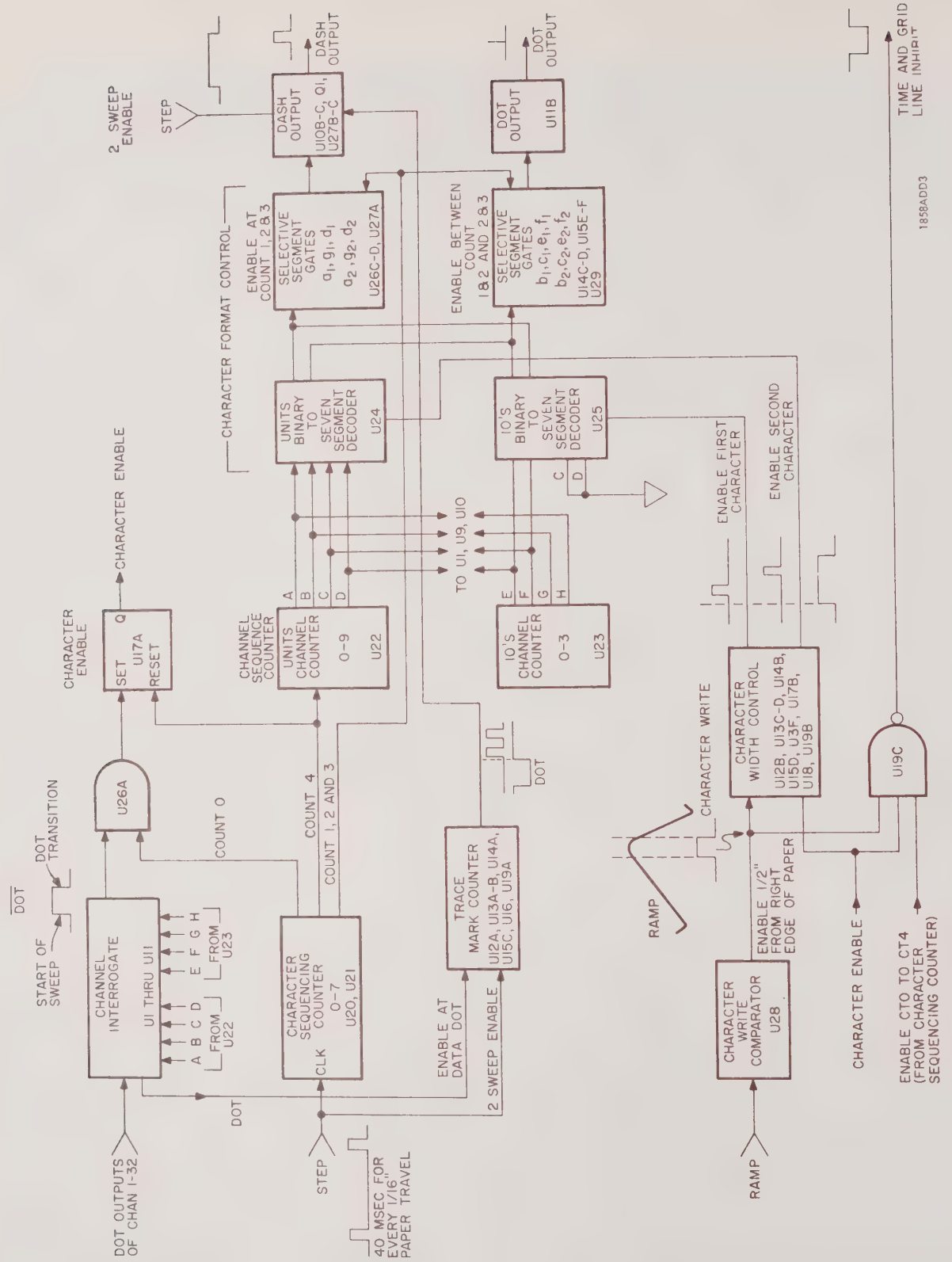


Figure 4-9. 32-Channel Trace Identifier Block Diagram

The step signals are counted by the 8-bit shift register U20. As shown in Figure 4-8, the U20 outputs go high one at a time for eight counts (0 through 7). During this period, the paper travels 1/2 inch. U21 samples the U20 outputs and insures that one and only one pulse is present in U20 during counts 0 through 6. On count 7, U21 inserts a new pulse into the input of U20.

Figure 4-11 shows how the character sequence counter controls the character format. When a plug-in module is installed in a given channel slot, the $\overline{\text{dot}}$ signal goes high at the beginning of each CRT beam sweep. On the count 0 of U20, U26A sets the character enable flip-flop U17A, which enables the character width control and timeline-gridline inhibit gate.

At the count 0, U19C inhibits the timelines and gridlines. On counts 1, 2, and 3, the characters are displayed. On count 4, U17A is reset to enable the timelines and gridlines and the channel sequence counter U22 is advanced one count to select the next higher numbered channel.

The U22 outputs feed binary coded decimal information to U1 to select the units numbered channels 0 through 9. U23 section A and B switch gates U9 and U10A to select the tens groupings of channels 0-9, 10-19, 20-29, and 30-39. If the Model 1870 Amplifier Housing is not used, jumper J1 is positioned C to 1 to inhibit U23B and limit the counter to channels 1 through 18.

The trace mark counter controls the trace identifying marks, which are two dashes displayed just to the right of the selected data trace. When the step signal goes high for two sweeps during count 2 of the character sequence counter and the dot signal from the selected data channel goes high, U19A enables the trace mark oscillator through inverters U13A and U13B. U16 monitors the U12A output and shuts off U14A and U12A after four pulses are generated. The Q_B output of U16 divides the oscillator signal by 2 and routes the two pulses to the dash output at U27A (see Figure 4-12).

The trace mark oscillator U12A is a conventional RC circuit with a start delay circuit added. While U13B output is low R31, R32, R33, and R38 form a balanced bridge which hold the positive and negative inputs to U12A at the same potential inhibiting oscillations. As U13B goes high, R32 is removed from the circuit and oscillation begins. However, C9 is initially charged through R32 and R38 and a slight delay occurs before C9 is discharged enough for the oscillations to begin.

The character width control produces two pulses about 120 nsec duration which unblank the "units" and "tens" BCD to the seven segment decoder/drivers U24 and U25 to write the trace identification numbers.

Comparator U28 produces a character write pulse when the ramp signal is more positive than 3.5 volts which corresponds to a trace position about 1/2 inch from the right side of the display. When the character enable signal from U17A is present, indicating that a plug-in module is installed, and U28 fires, U19B starts U12B. The U12B output is monitored by shift register U18 character width control through U14B. The

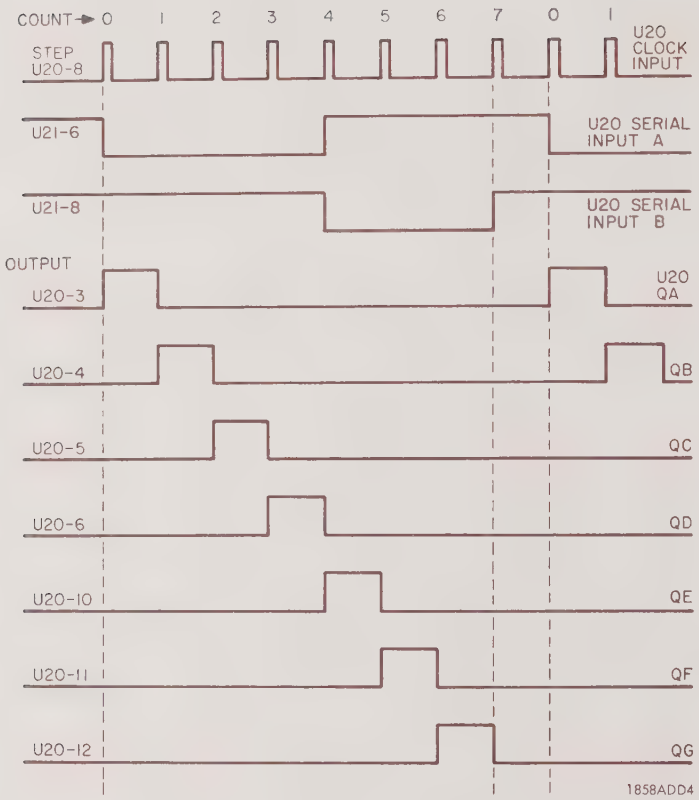


Figure 4-10. Character Sequencing Counter Waveforms

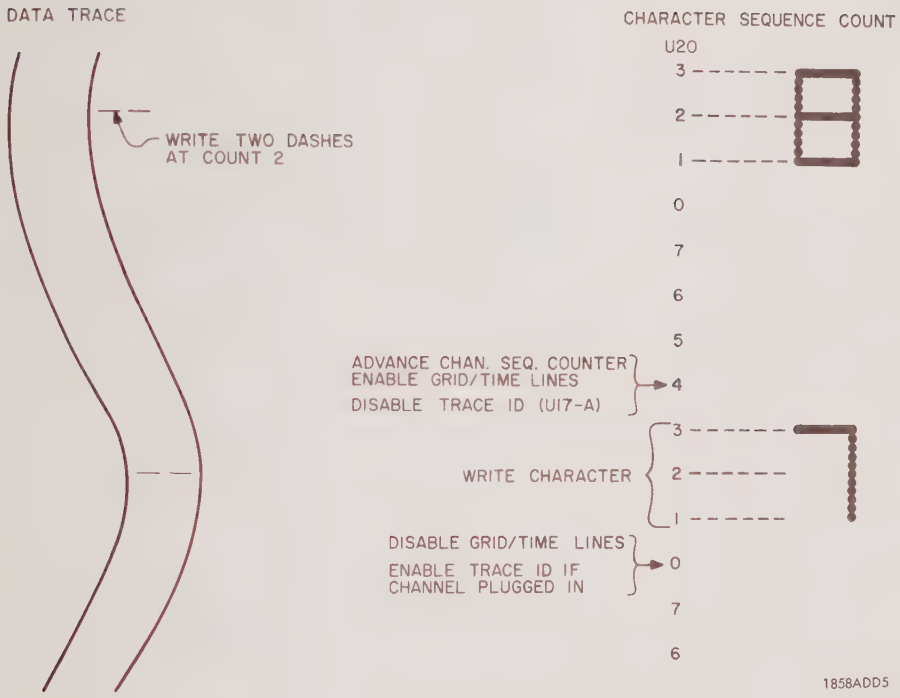


Figure 4-11. Character Sequence and Format Relationships

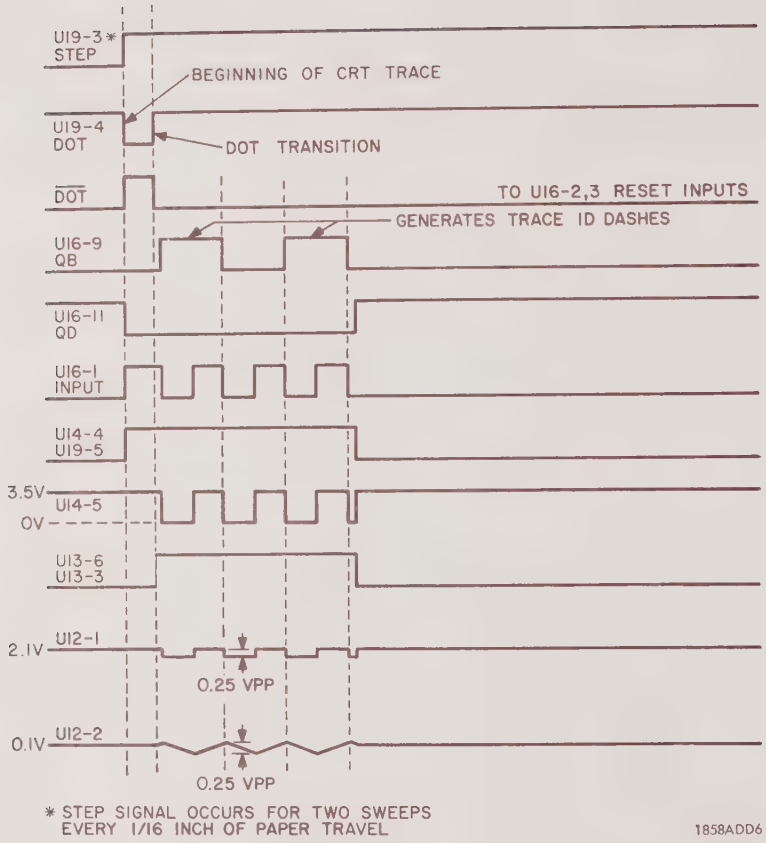


Figure 4-12. Trace Mark Counter Waveforms

second pulse triggers U18 pin 14 to enable the "tens" decoder U25 to write the character selected by U23 the dash control and dot control gates. The fourth pulse triggers U18 pin 11 to enable the U24 decoder to write the selected "units" number. Each of these enabling pulses lasts about 120 nsec. As the fourth pulse is completed the Q_E output of U18 goes high and inhibits U12B. (See Figure 4-13.)

The dash control and dot control gate individually process the seven segment character as shown in Figure 4-14. The gate outputs are routed to the video amplifier and processed as any other display signal.

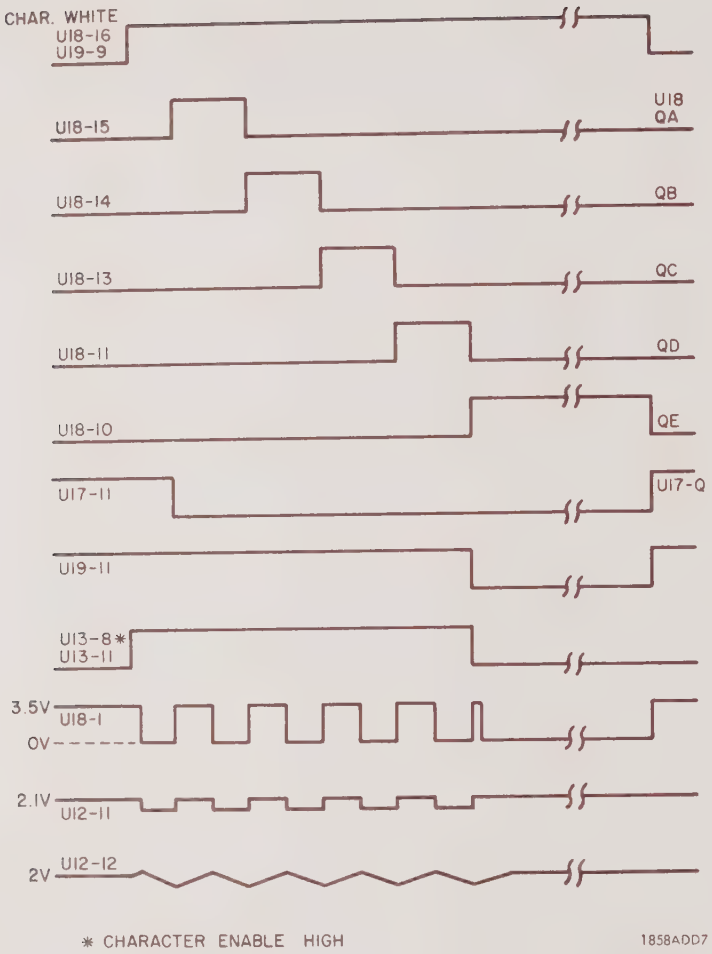


Figure 4-13. Character Width Control Waveforms

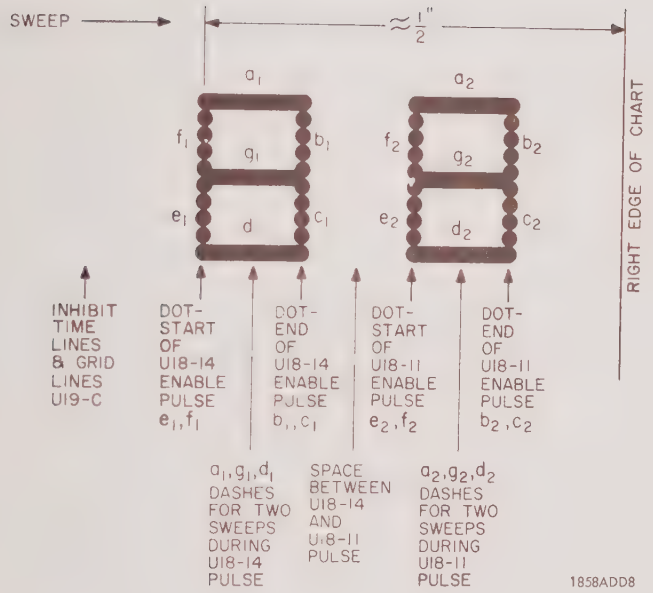


Figure 4-14. Character Segment Breakdown

Table 4-1. 1870 Interface Cable Connections

J1 PIN NO.	COLOR	SIGNAL
1 to P1-12	BRN	COMMON
2 to P1-7	ORN	20-29 COUNT
3 to P1-4	YEL	BCD-C
4 to P1-6	GRN	BCD-A
6 to P1-1	BLU	19 COUNT
8 to P1-8	VIO	30-32 COUNT
9 to P1-3	GRA	BCD-D
10 to P1-5	WHT	BCD-B
11 to P1-11	WHT-BLK	CLOCK
12 to P1-2	WHT-BLK-BRN	LINE
13 to P1-9	WHT-BLK-RD	RETRACE
14 to P1-10	WHT-BLK-ORN	COMMON
5 A3A3 J2	RED	RAMP
7 A3A3 J5	BLK	RTN

Twist

Twist

WARNING

THE MAINTENANCE INSTRUCTIONS ARE FOR USE BY QUALIFIED PERSONNEL ONLY. TO AVOID ELECTRIC SHOCK, DO NOT PERFORM ANY MAINTENANCE OTHER THAN THAT CONTAINED IN THE OPERATING INSTRUCTIONS UNLESS YOU ARE QUALIFIED TO DO SO.

SECTION 5

MAINTENANCE

5-1. GENERAL

This section describes preventive and corrective maintenance for the Model 1858 CRT Recorder. Preventive maintenance consists of routine checkout procedures performed at regular intervals without special tools or test equipment. Corrective maintenance includes basic troubleshooting, repair and replacement of parts, and calibration procedures.

5-2. SAFETY PRECAUTIONS

A. ELECTRICAL SAFETY

WARNING

The instrument contains lethal voltages. Up to -10,000 Vdc is present across certain points in the high voltage assembly. CARELESS OR IMPROPER HANDLING CAN RESULT IN SERIOUS INJURY OR DEATH. Never perform maintenance with power applied unless absolutely necessary to perform adjustment or make tests with power applied, observe the following precaution:

1. Place the instrument on a workbench made entirely of insulating material with no metal trim. Use a rubber floor mat insulated to at least 15 kV.

2. Ensure that instrument chassis and test equipment chassis are connected to earth ground, except where specifically noted.

3. Restrict the test area to qualified technicians.

4. Remove all metal objects from person, including rings, tie clasps, pens and pencils.

5. Use an insulated tuning wand rather than a screwdriver for making adjustments.

6. Avoid placing any body member in close proximity to any high voltage area.

7. After turning power off, wait for high voltages to discharge. Bleeder resistors should drain off all power in one minute when all circuit cards are properly installed.

B. FO-CRT SAFETY

WARNING

Cathode-ray tubes are very delicate and are subject to damage or breakage if handled carelessly. IF BROKEN, THE RESULTING IMPLOSION CAN SCATTER GLASS FRAGMENTS WITH DESTRUCTIVE FORCE. To ensure safety, a person handling cathode-ray tubes must observe the following precautions:

1. Wear a full face shield and gloves.

2. The work area must be a walled-in enclosure (screening is not sufficient) and admission restricted to those properly attired.

3. Perform work on a soft padded surface free from grit and dirt.

4. Avoid scratching the faceplate of the FO-CRT. Remove fingerprints or other foreign matter using isopropyl alcohol and a soft, clean, cotton cloth.

CAUTION

Rapid and extreme temperature variations may cause the glass CRT's to fracture. Temperature variations should not exceed 10 °C per minute.

5-3. PREVENTIVE MAINTENANCE

Preventive maintenance includes regular scheduled inspections and routine cleaning. No lubrication is required. The recommended time intervals are to be considered maximum. Heavy usage, adverse conditions, or local maintenance procedures may dictate more frequent inspections. Table 5-1 contains a full list of periodic inspections.

Table 5-1. Periodic Inspections

ITEM	PROCEDURE	RECOMMENDED INTERVAL
Paper Cradle	Vacuum area to eliminate paper scraps.	Daily
FO-CRT Faceplate	Clean FO-CRT faceplate with a soft, clean, cotton cloth dampened with isopropyl alcohol.	Daily
Ventilating covers and heat sink	Vacuum top, bottom, and side covers and rear panel heat sink to insure proper cooling.	Monthly
Model 1858 Performance	Use checkout procedure in paragraph 2-5.	Monthly
Plug-in Modules	Use procedure in applicable manual.	As required by manual or application.

5-4. CORRECTIVE MAINTENANCE

Corrective maintenance includes troubleshooting, fuse and lamp replacement, disassembly, and calibration procedures. Refer to Table 5-2 for recommended test equipment. The service kit (Honeywell Part No. 16776102-001) contains extender cards and replacement fuses for maintenance.

CAUTION

Exercise extreme caution when using oscilloscope probes on extender card connectors. Even momentary shorting of adjacent clad runs can result in extensive damage to the instrument.

A. TROUBLESHOOTING (Model 1858)

Troubleshoot the instrument by starting with a malfunction indication and checking each functional system involved to isolate the assembly containing the faulty component or maladjustment. A thorough understanding of the theory of operation (Section 4) aids the technician in troubleshooting. When the malfunction is isolated

Table 5-2. Recommended Test Equipment

MANUFACTURER	MODEL	DESCRIPTION
Tektronix	Series 465 or equivalent.	Oscilloscope, 100 MHz with 10:1 probe.
Triplett	630NA	Multimeter
Beckman	6225	Frequency Counter
User Modified		Scale, Inch decimal Divisions, cut to 8 inch length.
User Manufactured		Resistive load 0-100 ohm, 50W min, slidewire-or substitute described in Figure 5-2.
User Manufactured		Resistive Load 0-1.0 ohm, 50W min, slidewire-or substitute described in Fig. 5-3.

to a particular circuit, locate the faulty component using standard voltage and resistance checks. Refer to Section 7 for schematic diagrams. Use the following general guidelines to locate the malfunction.

1. Observe the proper polarity when making dc voltage checks.

2. V_{BE} is approximately 0.6 volt for a conducting transistor.

3. The voltage across a forward biased diode should be approximately 0.7 volt.

4. Each instrument is tested and calibrated before shipment. The following assumptions should be made in troubleshooting:

   a. The instrument is wired correctly.

   b. Transistor problems are usually limited to: open, short, and noise.

   c. Diode failures are: open or shorted.

   d. Resistors open or increase in value.

   e. Capacitors open or short.

5. Exact transistor and diode replacements should be made if possible.

6. Precision resistors and zener diodes should be replaced with identical components.

7. Consult the parts list (Section 6) for the correct identification of any component.

8. Intermittent malfunctions may be caused by dirty contacts on either the plug-in modules or the slide-in circuit cards. Clean the contacts by using a soft cloth moistened with pure (not denatured) grain alcohol, clean the contact fingers at the rear of the module or circuit card. Dry the contacts and adjacent surfaces with a soft cloth. Re-install the module and check for proper function.

B. TROUBLESHOOTING (PLUG-IN MODULES)

Specific troubleshooting procedures for the various Signal Conditioning Plug-in Modules are located in their separate manuals. Figure 5-1 presents the typical rear panel to module connector wiring diagram for odd and even number channels.

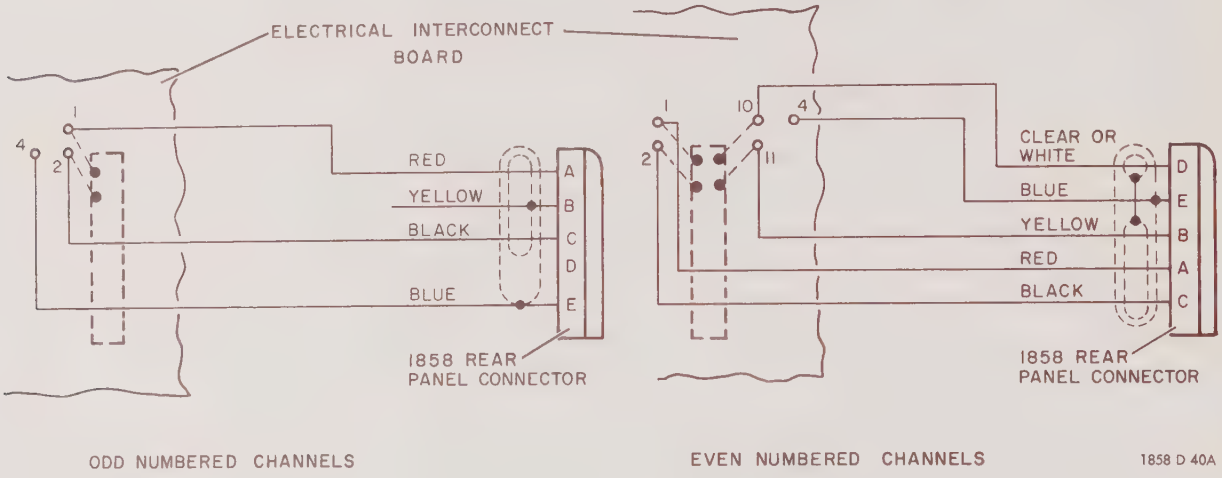


Figure 5-1. Typical Plug-In Input Wiring

C. FUSE AND LAMP REPLACEMENT

Three power supply fuses are located inside the top cover. If replacement of a fuse is necessary, ensure that system is off before inserting the new fuse. Use only identical replacement fuses. See Figure 5-7.

Both the POWER and the DRIVE pushbutton switches contain indicator lamps. These are long life lamps and should seldom need replacement. In the event of lamp failure proceed as follows:

1. Remove the pushbutton lamp lens by pulling forward on the button.

2. Remove the lamp from the switch and insert an identical replacement lamp.

3. Reinstall the lens button by pressing it firmly in place.

D. DISASSEMBLY

1. Maintenance Access

Most of the troubleshooting or servicing of the instrument may be performed with only the top and bottom covers removed and the rear panel released.

a. Remove the two screws at the outside edges of the top cover, and slide the cover toward the rear to remove.

b. Remove the two screws at the outside edges of the bottom cover, and slide the cover toward the rear to remove.

c. Release the rear panel by removing the 6 screws around the perimeter of the panel. The panel may now be opened on the hinges along the lower edge.

CAUTION

When the bottom cover is removed, there is insufficient clearance for proper convection cooling or easy opening of the rear panel.

Both problems can be minimized by raising the instrument about 1 inch on wooden blocks or setting the unit on its side (transport side up).

2. Circuit Cards

a. Slide-in circuit cards A3A1 through A3A7 may be removed for inspection or troubleshooting simply by sliding them out of the A3 card holder.

CAUTION

The video amplifier A3A1 has direct wire connections which must be disconnected before the card can be completely withdrawn from the instrument.

b. To reinstall any of these circuit cards, merely place the card in the proper slot. Slide the card completely into its slot and make sure that it seats properly in the card connector.

c. Reinstallation of the video amplifier requires proper seating in the card slot and reconnection of the RED wire (to the high voltage assembly) at quick disconnect terminal B. The VIOLET wire (also connected to the high voltage assembly) reconnects to terminal E on the video amplifier.

d. The servo circuit card A1A1 is part of the front panel assembly. The position of the servo card makes it highly accessible for most testing procedures in place. If removal is necessary, proceed as follows:

(1) Remove top and bottom trim strips (two screws on top, five screws on bottom).

(2) Set the unit on a padded surface in the normal operating position.

(3) Remove the screw in the circuit card near the edge toward the FO-CRT.

(4) Slide off the small connector toward the FO-CRT.

(5) Disconnect the cable connector at the top of the front interconnect board.

(6) Gently slide the front panel and servo card assembly forward out of the unit and the connector to the interconnect board.

NOTE

The wires to the POWER pushbutton switch remain connected. There is enough slack in the wires to permit the required panel movement.

On reinstallation of the assembly, carefully redress the cable down the frame rib and along bottom of side plate toward the rear instrument. Remove side cover if necessary (four screws).

(7) Remove the screw at each end of the card-to-panel mounting bracket. Remove the servo card from the panel.

(8) Remove two screws at the bottom of the POWER pushbutton bracket.

(9) To reinstall the servo card, reverse the procedure. Check pushbuttons for free operation after the card is attached to the panel and before tightening screws mentioned in step 7.

NOTE

On reinstallation the cable to the AUXILIARY connector is dressed along the upper edge of the front panel.

3. High Voltage Assembly

WARNING

Insure that the POWER cable is disconnected and that all circuits have discharged. Allow one minute for discharge.

WARNING (Cont'd)

The high voltage assembly contains lethal voltages up to -10,000V. Use extreme care when working near or on this assembly, and observe the precautions in paragraph 5-2. A.

If handling of the assembly is required to gain access to subassemblies, the technician should wear rubber gloves or handle the assembly only by the lower two inches of the A3A11 circuit card. If the assembly becomes dirty or component replacement is necessary, clean the entire assembly with alcohol and retreat it with HumiSeal coating. (HumiSeal, Columbia Technical Corporation, Woodside, N. Y. 11377.)

NOTE

A small corona is allowable during operation in conditions of high humidity.

a. Remove the two screws attaching the high voltage assembly bracket to the bottom of the unit.

WARNING

On reassembly, the screws mentioned in step a. must be tightly in place before power is applied to the unit.

b. Remove four nylon nuts from the outside of the shield on the high voltage assembly and remove the shield.

c. Remove the Phillips head screw which attaches the FO-CRT shield to the support bracket on the high voltage assembly.

d. Pull the video amplifier A3A1 far enough out to disconnect the RED wire at terminal B and the VIOLET wire at terminal E.

e. Gently tilt the assembly back and disconnect the FO-CRT from its tube socket.

f. Disconnect the four direct wire connections from the yoke to the high voltage assembly A3A11 and the cable wires attached to J6 and J7.

g. Pull off the connector at the bottom of the A3A11 circuit card and back out the assembly out of the unit.

h. Reverse the procedure to install the high voltage assembly. Reconnect the direct wire connections as follows:

J1-BLUE	J4-GREEN
J2-RED	J6-WHITE-RED-RED
J3-YELLOW	J7-WHITE-RED-BLACK

WARNING

Under no circumstances, should operation of the instrument be attempted without the high voltage shield in place and the two mounting bracket screws tightly in place.

4. FO-CRT A4V1

a. Remove the left side cover (four screws).

CAUTION

On reassembly, the same 1/4 inch long screws must be used to attach the side cover or binding of the transport drive may result.

b. Remove the left screw in the top and bottom trim strips.

c. Remove the left side casting (three screws along the bottom edge).

d. Remove the high voltage assembly (paragraph 5-4.D.3.).

e. Remove one screw on each side at the waist of the FO-CRT shield.

f. Remove two screws at the front upper edge of the shield.

NOTE

On reinstallation, insure that the grounding wire to the right hand screw in step f. is reattached.

WARNING

Observe the safety precautions for FO-CRT handling described in paragraph 5-2.B.

g. Gently back the FO-CRT out of the aperture in the transport module, then lift it out of the instrument to a prepared, padded work bench.

h. To reinstall the FO-CRT, reverse the procedure. Use extreme care in positioning the faceplate through the transport module aperture. Check the felt tape along the transport aperture edges after the FO-CRT is in position. Insure that the face plate rests against the vertical edges of the aperture. If necessary, loosen the FO-CRT shield clamp.

NOTE

If the FO-CRT shield clamp is loosened, the clamp screw must be retightened to 45 inch-ounces.

i. After installation of a FO-CRT, recalibration of the display system according to paragraph 5-4.E.2. is required.

5. Transport Module

a. Remove the left side cover and casting (paragraph 5-4. D.4. a. through c.).

b. Remove the high voltage assembly (paragraph 5-4. D. 3.).

CAUTION

On reassembly, insure that the proper 1/4 inch long screws are used for the side cover.

c. The FO-CRT may be removed (paragraph 5-4.D.4) or allowed to remain with the transport module.

d. Disconnect the blue and black wires at A4C1 + and - respectively.

e. Remove the outer paper door. Use a screw driver blade to partially release the flat spring loaded hinge pins at the bottom of the door. Do not spread the flat spring for enough to allow the hinge pins to fall out.

f. Remove the top trim strip (two screws).

g. Remove five screws from the bottom panel of the instrument.

h. Lift the module out of the instrument.

Table 5-3. Power Supply Voltages

VOLTAGE	LOCATION	ADJUSTMENT
-12.0±0.1	A3A7 pin 13	A3A7R22
+12.0±0.1	A3A7 pin 10	A3A7R20
+40.0±0.2	A3A6 pin 4	A3A6R8
+5.0+0.05	A3A6 pin 15	A3A6R14

i. To reinstall the transport module, reverse the procedure.

E. CALIBRATION

Calibration or verification of the power supply voltages should be performed before calibration of any other circuits in the Model 1858. Recalibration is recommended whenever components in the adjustable circuits have been replaced and as part of a monthly maintenance routine to assure optimum performance. Read the entire calibration procedure before attempting calibration.

NOTE

Power supply voltages may be checked in accordance with Table 5-3. If all voltages are within the allowable limits, calibration of the power supplies should not be required.

1. Power Supplies

Because of the extreme sensitivity of the display circuits, recalibration of the power supplies may necessitate recalibration of the entire system.

a. -12 Vdc Regulator (Circuit Card A3A7)

(1) Remove the top and bottom covers and open the rear panel.

(2) Remove the ±12 Vdc power supply regulator circuit card A3A7.

(3) Install the extender card in the A3A7 card slot and mount the ±12 Vdc power supply card in the extender card . Slide back the insulation on the extender card wire loops to allow for test equipment connections.

(4) Back all A3 circuit cards except the +40 Vdc and +5 Vdc power supply card A3A6 out of the connector.

(5) Open the paper cradle to disable the paper drive servo.

(6) Slide off the connector at the bottom of the high voltage assembly A3A11.

(7) Slide out all plug-in modules.

(8) Set a 100 watt variable resistive load to 15.8 ohms. If this item is not available, a suitable substitute can be made from standard parts as shown in Figure 5-2 below.

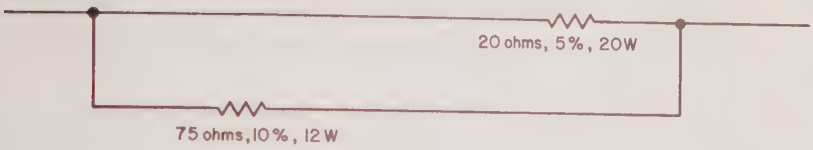


Figure 5-2. Locally Manufactured 15.8 Ohm Load

(9) Connect the resistive load between pin 13 on the extender card and the instrument chassis. (Pin 1 is at the top of the extender card.) Also connect a 25 ohm 7W resistor between pin 10 and chassis.

(10) Connect the voltmeter at the loop on pin 13 (-) and chassis ground.

(11) Adjust current limit control R23 (A3A7) to its maximum CCW position .

(12) Engage the POWER pushbutton.

(13) Adjust R22 (A3A7) for a reading on the voltmeter of -12 Vdc $\pm$0.1V.

(14) Turn R23 (A3A7) clockwise until the voltmeter reading drops 50 to 200 millivolts. This sets the current limit to 725-800 mA.

(15) Release the POWER pushbutton.

b. +12 Vdc Regulator (Circuit Card A3A7)

(1) Move the test equipment from the loop on pin 13 to the loop on pin 10 and connect a 25 ohm 7W resistor between pin 13 and chassis. Remember to change the polarity of the voltmeter.

(2) Adjust current limit control R21 (A3A7) to its maximum CCW position.

(3) Engage the POWER pushbutton.

(4) Adjust R20 (A3A7) for +12 Vdc $\pm$0.1V.

(5) Turn R21 (A3A7) clockwise, until voltmeter reading drops 50 to 200 mV. This sets the current limit to 725-800 mA.

(6) Release the POWER pushbutton. Disconnect the test equipment and return the ±12 Vdc regulator card to the A3A7 card slot.

c. +40 Vdc and +5 Vdc Power Supply Circuit Card A3A6.

(1) Remove the +40 Vdc and +5 Vdc power supply circuit card.

(2) Install the extender card in the A3A6 card slot and mount the +40 Vdc and +5 Vdc power supply card in the extender card.

NOTE

With exception of the ±12 Vdc regulator circuit card, which was reinstalled in step 5-4. E. 1. b. (6), the setup of the instrument remains as established in steps 5-4. E. 1. a. (4) through (7).

(3) Adjust the variable 100 watt load to 40 ohms. The 40 ohm load may be made from standard parts as shown in Figure 5-3.

Connect the 40 ohm load from pin 4 on the extender card to the instrument chassis.

Figure 5-3. Locally Manufactured 40 Ohm Load.

(4) Connect the voltmeter between the pin 4 loop (+) and the instrument chassis.

(5) Adjust current limit control R10 (A3A6) to maximum CCW position.

(6) Engage the POWER pushbutton.

(7) Adjust R8 (A3A6) for a voltmeter reading of 40 Vdc ±0.2V.

(8) Turn R10 (A3A6) clockwise until the voltmeter reading drops 50 - 200 mV. This sets the current limit to .95 - 1.05 amperes.

(9) Release the POWER pushbutton. Remove the voltmeter and resistive load.

(10) Connect the + terminal of the voltmeter to A3A6, pin 15, and the - terminal to the chassis.

(11) Adjust a 100 watt variable load to 2/3 ohm or make up the load shown in Figure 5-4.

Connect load and ammeter from A3TB1-5 to the chassis. Set ammeter to 12 ampere scale.

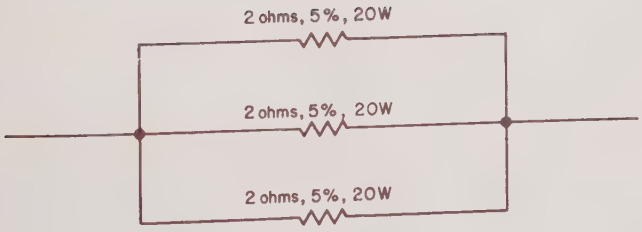
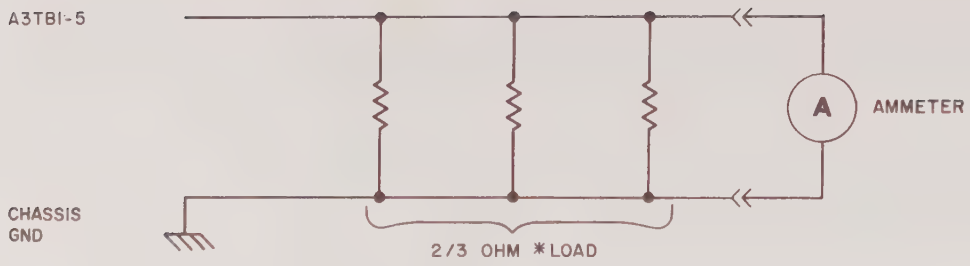


Figure 5-4. Locally Manufactured 2/3 Ohm Load



*Including test lead resistance

Figure 5-5. Short Circuit Current Measurement Set Up.

NOTE

The ammeter connected in Figure 5-5 shorts out the 5 volt supply so the short circuit current may be measured.

NOTE

Unless components of this +5 Vdc circuit have been replaced, omit step (12).

(12) Adjust current limit control R18 (A3A6) to its maximum CW position. Adjust R20 (A3A6) to its maximum CCW position.

(13) Engage the POWER pushbutton.

(14) Adjust short circuit current control R20 (A3A6) for a 1 - 1.2 amp reading.

(15) Remove the ammeter. Adjust R14 (A3A6) for 5.0 Vdc ±.05 V. R18 (A3A6) may have to be turned CW 2 or 3 times to achieve this adjustment.

(16) Adjust R18 (A3A6) CCW until the voltmeter reading drops 25 to 100 millivolts.

(17) Reconnect ammeter across the 2/3 ohm load and readjust R20 (A3A6) for a 1 - 1.2 amp reading.

(18) Remove ammeter and readjust R18 (A3A6) until the voltmeter reading drops 25 - 110 mV below 5V. The short circuit current is now set to between 0.9 and 1.3 A and the foldback is between 7.1 and 7.9A.

(19) Release the POWER pushbutton. Remove resistive load and test equipment. Reinstall the regulator circuit card in the A3A6 slot.

(20) Slide all A3 circuit cards firmly into their connector. Close the paper cradle.

(21) Reinstall connector on the bottom of the high voltage card A3A11.

NOTE

Do not slide in the plug-in modules.

2. Display System Calibrations

The following series of calibrations form a single calibration of the display system and are separately identified only for clarity. With the exception of steps a.(3) through a. (5), the entire procedure must be performed in sequence from beginning to end to achieve calibration of the display system.

NOTE

The final focus adjustment is located in gridline calibration section paragraph 5-4.E.2.f. because of availability of a known signal

a. PAPER Supply Indicator

(1) Remove the clock circuit card A3A3, install it on the 30/60 pin extender card and reinstall the assembly in the A3A3 card slot.

(2) Engage the POWER pushbutton.

(3) Open the cradle and remove paper.

(4) If the PAPER supply indicator does not read E, loosen the set screw on the paper sensor arm and position the sensor resistor (small screw at the pivot of the sensor arm) to achieve an E reading on the indicator. Retighten the set screw.

NOTE

Do not try to make this adjustment by removing the sensing arm - it is spring loaded and difficult to re-install.

(5) Fully depress the paper sensor arm and adjust A3A3R25 for an F reading on the indicator. Release the sensor arm. The indicator reading should return to E.

This adjustment will be approximately correct for the largest roll of paper used in the machine. If desired, the calibration can be made with a full roll of paper installed of the type planned for use with the machine.

b. Clock Oscillator

(1) Connect a frequency counter to J3 (A3A3). Set the counter start slope to + and the stop slope to +.
Adjust the counter controls to determine the period of the square wave.

(2) Adjust R51 (A3A3) to achieve a counter reading of 20 μsec ±0.2 μsec. Remove the counter.

(3) Release the POWER pushbutton.

WARNING

The following series of steps requires working in close proximity to the high voltage card and its lethal voltages. Observe the electrical precautions described in paragraph 5-2.

CAUTION

The high voltage card must be securely bolted to the chassis whenever turning power on with the high voltage card installed.

c. Ramp Signal

(1) Place jumper A3A1J1 (video card) in the C to 2 position. Connect the red and violet leads from the high voltage card to pins B and E respectively on the A3A1 video card.

(2) Connect the oscilloscope probe to A3A3J2 (clock card). Use internal triggering.

(3) Connect a clip lead from A3A11 pin 3 (third pin from right at the rear of the high voltage power supply connector) and from A3A11, pin 6 sixth pin from right) to chassis ground.

(4) Engage the POWER pushbutton.

(5) Adjust A3A11R10 (intensity, on top left of the high voltage power supply) for a visible trace.

NOTE

Make sure the DRIVE pushbutton remains released.

(6) Hold a piece of recording paper against the CRT, and adjust A3A11R1 (through the opening on bottom of the high voltage power supply) for a trace length of eight inches (width of recording paper). If one end of trace is off edge of CRT, adjust the magnets on CRT neck to bring edge on CRT for adjustment of eight inches. Do not be concerned about vertical or horizontal centering at this point.

(7) If required, rotate yoke for a horizontal display.

(8) Adjust intensity (A3A11R10 on top left of the high voltage power supply) maximum CCW for no display.

(9) Adjust A3A3R1 (on clock card) for 7.2 ±.05 V p-p ramp amplitude on oscilloscope.

(10) Adjust A3A11R1 (through opening on bottom of the unit) for 8.4 ±0.1V p-p ramp amplitude on oscilloscope.

(11) Adjust A3A3R82 (clock card) so that the ramp is centered around O V.

(12) Engage DRIVE pushbutton and adjust A3A11R10 for a barely visible trace. Hold a scale against CRT. Adjust A3A3R1 for 7.85 ±0.05 inches of trace on CRT.

(13) Run paper at 1 IN/SEC. Adjust magnet so that right edge of trace is printed on right edge of paper within 0.05 inch or less, and trace is centered vertically on CRT face.

(14) Verify that ramp signal is centered around O V and exceeds 4.2 V in each direction above and below O V.

(15) Release DRIVE and POWER pushbuttons.

d. Vertical Oscillator

(1) Install the wire link jumper J1 (A3A3) in the C to 2 position.

(2) Remove the wire jumper from A3A11, pin 6 to ground on the high voltage card.

(3) Engage the POWER and DRIVE pushbuttons.

(4) Adjust R46 (A3A3) to center the raster vertically on the CRT aperature.

(5) Adjust R45 (A3A3) for a vertical raster height of 0.2 to 0.22 inches.

(6) Release the DRIVE and POWER pushbuttons.

(7) Remove the extender card from the A3A3 slot. Move J1 jumper on the clock card (A3A3) to the C to 1 position.

(8) Install clock card in the A3A3 slot.

(9) On the video card, move jumper J1 to the C to 1 position.

(10) Remove the wire jumper from pin 3 to ground on the high voltage card.

e. Gridline Generator A3A4

(1) Remove the gridline generator card. Install

it on an extender card and install the assembly in the A3A4 card slot.

(2) Lock in the POWER pushbutton

(3) Monitor the anode of A3A4VR1 with a voltmeter.

(4) Adjust A3A4R20 for a voltmeter reading of -6.5 Vdc ±0.05V.

(5) Disconnect the voltmeter.

(6) Set the GRIDLINE switch to CONTinuous.

(7) If the timeline option is present, set the TIMELINE control to .01 SEC.

(8) Release all MULTIPLIER and RECORD SPEED pushbuttons.

(9) Open the paper cradle and engage the DRIVE pushbutton.

(10) The display on the CRT should appear as shown in Figure 5-6.

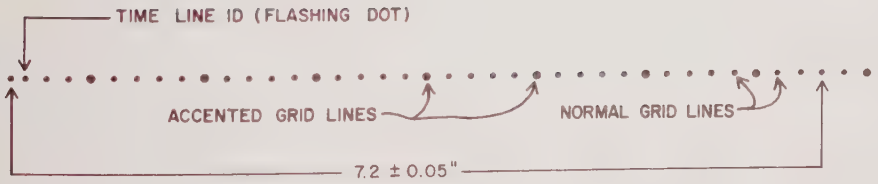


Figure 5-6. Gridline Display.

(11) If the display is not present, adjust R24 (A3A4) CCW until the accented gridlines appear.

(12) If the accented gridline does not appear in step (12) adjust R31 (A3A4) CCW.

(13) Adjust A3A1R74 (video card) for medium intensity of the accented gridlines.

(14) Adjust A3A1C54 (video card) for medium intensity of the normal gridlines.

(15) Adjust R31 (A3A4) for 38 gridlines.

(16) Adjust R24 (A3A4) to position the first gridline coincidental with the flashing timeline identification dot at left side of the CRT.

If the timeline option is not present, this adjustment should place the first gridline 0.5 ± 0.12 inch from the left edge of the normal path of the recording paper.

NOTE

Steps (15) and (16) interact and may need to be repeated until the desired setup is achieved.

(17) Engage the 1 IN/SEC and x 1.0 pushbuttons. If the timeline option is present, set the TIMELINE switch for 1 SEC.

(18) Adjust R31 (A3A4) so that the spacing between 37 gridlines is 7.2 ± 0.05 inches. Make the initial adjustment with a ruler on the CRT, then run a record to make final adjustment. Each fifth line should be accented (wider) than the normal gridlines.

(19) Adjust R24 (A3A4) so that the left gridline coincides with the timeline identification marker, if present, or in position 0.5 inch from the left edge of the paper.

(20) After final adjustment, there may be 37, 38, or 39 gridlines present.

(21) Release the POWER pushbutton.

(22) Remove the extender card and reinstall the gridline generator card in the A3A4 card slot.

f. Video Adjustments

There are three adjustments on the video card which affect the line thickness and intensity on the record.

R64 sets the amplitude of the dashes which form the timelines.

R74 sets the amplitude of the dot signals which form the gridlines, data traces, timeline I.D.'s and the dot components of the trace numbers. C54 sets the intensity of the normal gridlines.

(1) Release the DRIVE pushbutton.

(2) Increase the intensity of the CRT presentation by adjusting R10 on the top left side of the high voltage card until visible. Then adjust R10 until the trace just disappears.

(3) Engage the DRIVE pushbutton, run a record and make the following adjustments on the video card.

(4) Adjust A3A11R17 for best gridline focus (right hand adjustment on top of high voltage power supply cover).

(5) Set A3A1R64 on the video card for the thinnest looking timelines on the paper. Make the adjustment from the rear of the instrument.

(6) Adjust A3A1R74 (at rear of video card) for crisp looking data signals and so that the vertical and horizontal strokes of trace numbers are about equal in intensity. The fifth accented gridlines will be almost the same thickness as the tenth accented time timelines.

(7) Adjust A3A1C54 (at rear of video card) so that the normal gridlines are about the same thickness as the timelines.

(8) If intensity of the pattern cannot be reduced sufficiently with A3A1R64 and/or A3A1R74 set at minimum, adjust A3A11R10 CCW (left hand adjustment on top of high voltage power supply cover).

3. Paper Drive Calibration

a. Engage the POWER pushbutton. Depress RECORD SPEED buttons 8 and 2. Depress X.1 MULTIPLIER button, If the timeline

option is present, set the TIMELINE control to 1 SEC. If the timeline option is not present, connect a 0.5 Hz squarewave from the function generator through one of the plug-in modules. Close cradle.

b. Engage the DRIVE pushbutton and run about 2 feet of paper. Adjust R19 on the servo card to attain a spacing of 10 ±0.2 inches between any two accented time lines. Turning R19 CCW increases the spacing between the time lines.

c. Depress the 1 IN/SEC pushbutton. Depress MULTIPLIER button x.1. Set TIMELINE switch to 10 SEConds. Engage the DRIVE pushbutton. Run about 2 feet of paper. Check for spacing of 10 ±0.2 inches between any two accented time lines. If necessary, adjust R17 on the servo card. If adjustment is necessary, repeat step 3.b, then 3.c as necessary to be within specification.

d. On the servo circuit card A1A1, connect a frequency counter to the R45 lead closest to Q2.

e. Set the RECORD TIMER to 60 and adjust A1A1R42 for a period reading on the counter of 268 milliseconds.

f. Set the RECORD TIMER to OFF and adjust A1A1R55 for a period reading of 1.68 milliseconds.

g. Repeat steps e and f until interaction is minimized and the correct readings are achieved.

h. Remove the frequency counter.

i. Open the paper cradle.

j. Set the RECORD TIMER to 60. Engage the DRIVE pushbutton and check with a watch to verify that the servo drives for 60 ±3 seconds.

k. If necessary, adjust A1A1R42 to achieve the correct time.

l. Release the DRIVE and POWER pushbuttons.

5-5. LOW LINE VOLTAGE

If local line voltage is known to be consistantly low (100 to 107V or 200 to 214V) the connections to the main power transformer may be modified to allow proper operation of the instrument. The connections are located on the upper side of the transformer.

A. With the power cable disconnected, remove the two screws at the outside edges of the top cover, and slide the cover toward the rear to remove.

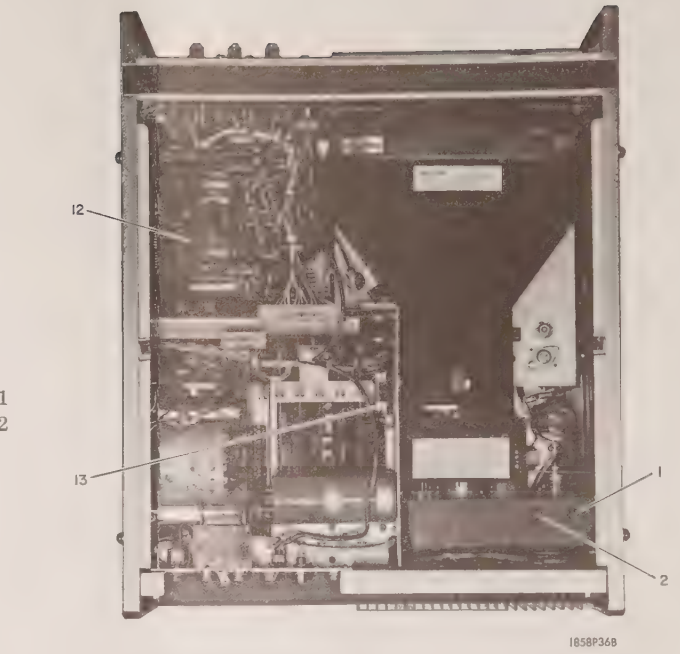
B. Desolder the wire at pin 15 of the transformer and re-solder it to pin 3.

C. Desolder the wires at pin 16 of the transformer and perform a continuity test to identify the wire going to the connector FOR 58L. Resolder this wire on pin 16.

D. Move the remaining wire from pin 16 to pin 4 and solder it there.

E. Reassembly the instrument by reversing procedure in step A.

1. A3A11R10
2. A3A11R17
3. High Voltage Assembly A3A11
4. A3TB1
5. Video Amplifier CCA A3A1
6. Trace Identifier CCA A3A2 (Optional)
7. Clock CCA A3A3
8. Gridline Generator CCA A3A4
9. Timeline CCA A3A5 (Optional)
10. +40V and +5V Power Supply CCA A3A6
11. ±12V Power Supply CCA A3A7
12. Servo CCA A1A1
13. Fuses (Stacked)
    F1-1.5A, Time Delay (Top)
    F2-0.125A, Time Delay
    F3-0.75A, Time Delay (Bottom)



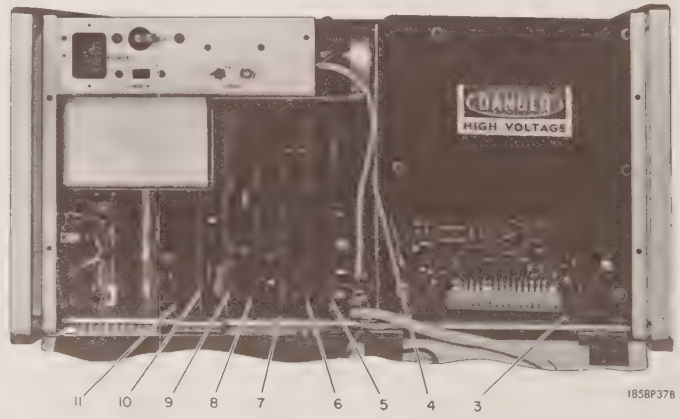


Figure 5-7. Top and Rear Views of Model 1858

ILLUSTRATED PARTS BREAKDOWN

6-1. GENERAL

THE PARTS LIST CONTAINS ALL REPLACEABLE PARTS, EXCEPT HARDWARE, INDENTED UNDER THEIR RESPECTIVE ASSEMBLIES AND SUBASSEMBLIES. THE ARRANGEMENT OF THE PARTS LIST IS IN DISASSEMBLY SEQUENCE WITHIN EACH TABLE, AND EACH ASSEMBLY IS BROKEN DOWN TO ITS LOWEST REPLACEABLE PART. AN EXPLANATION OF EACH COLUMN CONTAINED IN THE TABLE FOLLOWS:

A. FIGURE NUMBER

THIS COLUMN LISTS THE FIGURE NUMBER OF THE ILLUSTRATION ON WHICH A PARTICULAR INDEX NUMBER OR REFERENCE DESIGINATOR WILL BE FOUND.

B. INDEX NUMBER

THIS COLUMN LISTS THE INDEX NUMBER OF AN ITEM WHICH IS USED TO LOCATE THE ITEM IN ITS NEXT HIGHER ASSEMBLY ILLUSTRATION.

C. REFERENCE DESIGNATOR

THIS COLUMN LISTS THE SCHEMATIC, ASSEMBLY, OR ITEM REFERENCE DESIGNATION WHICH IS USED TO LOCATE ELECTRICAL AND ELECTRONIC ASSEMBLIES AND/OR ITEMS IN THEIR NEXT HIGHER ASSEMBLY ILLUSTRATIONS AND SCHEMATIC DIAGRAMS.

D. DESCRIPTION

THIS COLUMN LISTS, IN MOST CASES, THE APPROVED GOVERNMENT ITEM NAME AND MODIFIERS AS CONTAINED IN CATALOGING HANDBOOK H6-1. IN THE CASE OF STANDARD ELECTRONIC ITEMS AND HARDWARE, ADDITIONAL DATA HAS BEEN ADDED TO THE DESCRIPTION TO ENABLE PROCUREMENT OF A REPLACEMENT ITEM FROM LOCAL COMMERCIAL SOURCES.

E. MANUFACTURER'S CODE

THIS COLUMN LISTS THE MANUFACTURER'S FEDERAL SUPPLY CODE AS CONTAINED IN THE FEDERAL SUPPLY CODE FOR MANUFACTURERS (CATALOGING HANDBOOK H4-2). FOR THOSE ITEMS WHERE CODE 28009 IS USED, PROCUREMENT MUST BE MADE FROM HONEYWELL INCORPORATED, TEST INSTRUMENTS DIVISION, 4800 EAST DRY CREEK ROAD, DENVER, COLORADO 80217.

THE FEDERAL SUPPLY CODES FOR MANUFACTURERS OF ITEMS USED IN THIS EQUIPMENT, AND CONTAINED IN THE PARTS LIST, ARE LISTED

IN PARAGRAPH 6-5.

F. MANUFACTURER'S PART NUMBER/FEDERAL STOCK NUMBER

THIS COLUMN LISTS THE MANUFACTURER'S PART NUMBER ON THE FIRST LINE AND THE FEDERAL STOCK NUMBER, WHEN AVAILABLE, ON THE SECOND LINE.

NOTE

IN MOST INSTANCES WHERE FIXED COMPOSITION RESISTORS, FIXED FILM RESISTORS, AND STANDARD HARDWARE APPEAR IN THE PARTS LIST, THE GOVERNMENT SPECIFICATION PART NUMBER OR GOVERNMENT STANDARD PART NUMBER SHOWN MAY IDENTIFY AN ACCEPTABLE REPLACEMENT ITEM AND NOT NECESSARILY AN IDENTICAL REPLACEMENT ITEM.

G. HONEYWELL PART NUMBER

THIS COLUMN LISTS THE HONEYWELL PART NUMBER FOR AN ITEM. THIS NUMBER MUST BE USED WHENEVER PROCUREMENT IS BEING MADE FROM HONEYWELL INCORPORATED.

H. QUANTITY PER ASSEMBLY

THIS COLUMN LISTS THE NUMBER OF TIMES AN ITEM IS USED IN ITS NEXT HIGHER ASSEMBLY AT THE LOCATION INDICATED BY THE FIGURE AND INDEX NUMBER.

I. USABLE ON CODE

IN SOME CASES, CERTAIN COMPONENTS AND SUBASSEMBLIES VARY FROM UNIT TO UNIT DUE TO THE MANY OPTIONS AVAILABLE. TO IDENTIFY THE USABILITY OF ANY COMPONENT ON AN ASSEMBLY, EACH FIGURE SHOWS A BREAKDOWN OF VARIANCES REQUIRED FOR THAT FIGURE ONLY. IF NO CODES ARE SHOWN, THE COMPONENT IS USED ON ALL UNITS.

J. NOTES

THIS COLUMN LISTS THE NUMBER OF THE APPLICABLE NOTE LOCATED AT THE BOTTOM OF THE PAGE.

6-2. RECOMMENDED SPARE PARTS LIST

TABLES A AND B LIST THE RECOMMENDED NUMBER OF SPARE PARTS REQUIRED TO SUPPORT AN EQUIPMENT FOR ONE YEAR. THE SPARE PARTS RECOMMENDED ARE MOSTLY INSURANCE TYPE ITEMS AND THE QUANTITY WAS CALCULATED ON THE BASIS OF AN EQUIPMENT IN OPERATION FOR FIVE DAYS A WEEK AND EIGHT HOURS PER DAY OR 2,000 HOURS OF OPERATION.

TABLE A, OPERATOR'S LEVEL RECOMMENDED SPARE PARTS LIST, CONTAINS THE SPARE PARTS REQUIRED TO MAINTAIN THE EQUIPMENT WITH A MAXIMUM DOWN-TIME OF ONE HOUR. OPERATOR'S LEVEL MAINTENANCE IS DEFINED AS MAINTENANCE PERFORMED BY THE OPERATOR AND/OR TECHNICIAN AT THE LOCATION OF THE EQUIPMENT AND WITHIN THE DOWN-TIME CRITERION.

TABLE B, BENCH LEVEL RECOMMENDED SPARE PARTS LIST, CONTAINS THE SPARE PARTS REQUIRED TO MAINTAIN THE EQUIPMENT WHERE DOWN-TIME IS NOT A FACTOR. BENCH LEVEL MAINTENANCE IS DEFINED AS MAINTENANCE PERFORMED BY A TECHNICIAN IN A SHOP AND CONSISTS OF TASKS WHICH EXCEED A DOWN-TIME OF ONE HOUR.

6-3. ORDERING INFORMATION

WHEN ORDERING SPARE OR REPLACEMENT PARTS FROM HONEYWELL, ALWAYS SPECIFY THE FOLLOWING:

A. EQUIPMENT NAME

B. MODEL NUMBER

C. SERIAL NUMBER

D. PART DESCRIPTION

E. HONEYWELL PART NUMBER

SEND ALL ORDERS TO THE FOLLOWING ADDRESS:

HONEYWELL INCORPORATED
TEST INSTRUMENTS DIVISION
4800 EAST DRY CREEK ROAD
DENVER, COLORADO 80217
ATTN: SPARE PARTS DEPT.

6-4. PARTS LIST AND ILLUSTRATIONS

THE TABLES IN SECTION 6 LIST ALL REPLACEABLE PARTS USED IN THE EQUIPMENT. THESE TABLES PROVIDE A MEANS OF LOCATING SPARE OR REPLACEMENT PART INFORMATION THROUGH THE USE OF APPROPRIATE REFERENCES TO THEIR RELATED ILLUSTRATIONS.

6-5. MANUFACTURERS

THE FOLLOWING IS A NUMERIC LIST OF MANUFACTURER'S FEDERAL SUPPLY CODES APPEARING IN THE PARTS LIST ALONG WITH THE NAME AND ADDRESS OF THE MANUFACTURER.

NAME AND ADDRESS	CODE
STERLING INSTRUMENT DIV. OF DESIGNATRONICS INC. 76 EAST 2ND STREET MINEOLA, NEW YORK 11501	00328
FILM CAPACITORS INCORPORATED 100 8TH STREET PASSAIC, NEW JERSEY 07055	00686
AMP INCORPORATED P.O. BOX 3608 HARRISBURG, PENNSYLVANIA 17105	00779
GENERAL ELECTRIC COMPANY INDUSTRIAL & POWER CAPACITOR DEPT JOHN STREET HUDSON FALLS, NEW YORK 12839	01002
ALLENBRADLEY COMPANY 1201 SOUTH 2ND STREET MILWAUKEE, WISCONSIN 53204	01121
TEXAS INSTRUMENTS INCORPORATED SEMICONDUCTOR COMPONENTS DIVISION 13500 NORTH CENTRAL EXPRESSWAY DALLAS, TEXAS 75231	01295
THOMAS ELECTRONICS INCORPORATED 100 RIVERVIEW DRIVE WAYNE, NEW JERSEY 07470	01852
FERROXCUBE CORPORATION MT. MARION ROAD SAUGERTIES, NEW YORK 12477	02114
ARMSTRONG CORK COMPANY W. LIBERTY AND MARY STREET LANCASTER PENNSYLVANIA 17604	03938
JETTRON PRODUCTS, INCORPORATED 56 ROUTE 10 EAST HANOVER, NEW JERSEY 07936	04435
MOTOROLA INCORPORATED SEMICONDUCTOR PRODUCTS DIVISION PO BOX20922; 5005 E. MC DOWELL RD PHOENIX, ARIZONA 85036	04713
COSMO PLASTIC COMPANY 3239 WEST 14TH STREET CLEVELAND, OHIO 44109	05616
WAKEFIELD ENGINEERING INC. AUDUBON ROAD WAKEFIELD, MASSACHUSETTS 01880	05820
GENERAL ELECTRIC COMPANY ELEC. CAPACITOR & BATTERY DEPT. P.O. BOX 158 IRMO, SOUTH CAROLINA 29063	06001
E-T-A PRODUCTS CO. OF AMERICA 6284 NORTH CICERO AVENUE CHICAGO, ILLINOIS 60646	06402
AMATON ELECTRONIC HARDWARE DIVISION OF MITE CORPORATION 81 ROCKDALE AVENUE NEW ROCHELLE, NEW YORK 10802	06540
GENERAL DEVICES COMPANY INC. 525 SOUTH WEBSTER AVENUE INDIANAPOLIS, INDIANA 46219	06666
COMPONENTS INCORPORATED SEMCOR DIVISION 3540 WEST OSBORN ROAD PHOENIX, ARIZONA 85019	06751
ROBINSON NUGENT, INCORPORATED P.O. BOX 470 800 EAST EIGHT STREET NEW ALBANY, INDIANA 47150	06776
FAIRCHILD SEMICONDUCTOR A DIV. OF FAIRCHILD CAMERA & INST. CORP. 464 ELLIS STREET MOUNTAIN VIEW, CALIFORNIA 94040	07263
NPC ELECTRONICS P.O. BOX 1454 CANOGA PARK, CALIFORNIA 91304	08257
BREEZE CORPORATIONS INCORPORATED 700 LIBERTY AVENUE UNION, NEW JERSEY 07083	08484
GENERAL ELECTRIC COMPANY MINATURE LAMP DEPARTMENT NELA PARK CLEVELAND, OHIO 44112	08806
NYLOMATIC DIVISION OF WEHCO PLASTICS INCORPORATED NOLAN AVENUE NORRISVILLE, PENNSYLVANIA 19067	08863
CTS OF BERNE INCORPORATED 406 PARR ROAD BERNE, INDIANA 46711	11236
CTS KEENE INCORPORATED 3230 RIVERSIDE AVENUE PASO ROBLES, CALIFORNIA 93446	11237
IRC DIVISION OF TRW INCORPORATED BOONE PLANT GREENWAY ROAD BOONE, NORTH CAROLINA 28607	11502
ELPAC INCORPORATED 18651 VON KARMAN AVENUE IRVINE, CALIFORNIA 92664	12406
THERMALLOY COMPANY INCORPORATED P.O. BOX 34829 2021 WEST VALLEY VIEW LANE DALLAS, TEXAS 75234	13103
FAIRCHILD SEMICONDUCTOR A DIV. OF FAIRCHILD CAMERA & INST. CORP. 4300 REDWOOD HIGHWAY SAN RAFAEL, CALIFORNIA 94903	13715
MAGNETIC DEVICES INCORPORATED 7564 BROADWAY LEMON GROVE, CALIFORNIA 92045	13786
SEMTECH CORPORATION 652 MITCHELL ROAD NEWBURY PARK, CALIFORNIA 91320	14099
GENERAL INSTRUMENT CORPORATION SEMICONDUCTOR PRODUCTS GROUP 600 WEST JOHN STREET HICKSVILLE, NEW YORK 11802	14936
SPRUCE PINE MICA COMPANY P.O. BOX 219 SPRUCE PINE, NORTH CAROLINA 28777	16037
EDWIN GAYNOR COMPANY 480 BUNNELL STREET BRIDGEPORT, CONNECTICUT 06607	16592
SIGNETICS CORPORATION 811 EAST ARGUES AVENUE SUNNYVALE, CALIFORNIA 94086	18324

NAME AND ADDRESS	CODE
CHOMERICS, INCORPORATED 77 DRAGON COURTS WOLBURN, MASSACHUSETTS 01801	18565
VISHAY INTERTECHNOLOGY INC. RESISTOR PRODUCTS DIVISION 63 LINCOLN HIGHWAY MALVERN, PENNSYLVANIA 19355	18612
ERIE TECHNOLOGICAL PRODUCTS INC. STATE COLLEGE DIVISION STATE COLLEGE, PENNSYLVANIA 16801	18796
BUCKEYE STAMPING COMPANY 555 MARION ROAD COLUMBUS, OHIO 43207	21604
PHILCOFORD CORPORATION MICROELECTRONICS DIVISION 2920 SAN YSIDRO WAY SANTA CLARA, CALIFORNIA 95051	21989
NIPPON MINATURE BEARING CO. LTD. TOYKO, JAPAN	23589
MIALUSA INCORPORATED 163 FRANKLIN AVENUE NUTLEY, NEW JERSEY 07110	26625
NATIONAL SEMICONDUCTOR CORP. 2950 SAN YSIDRO WAY SANTA CLARA, CALIFORNIA 95051	27014
VARO INCORPORATED ELECTRON DEVICES DIVISION GARLAND, TEXAS 75040	27777
HONEYWELL INCORPORATED TEST INSTRUMENTS DIVISION 4800 EAST DRY CREEK ROAD DENVER, COLORADO 80217	28009
HEWLETT PACKARD COMPANY 1501 PAGE MILL ROAD PALO ALTO, CALIFORNIA 94304	28480
HEYMAN MANUFACTURING COMPANY 147 NORTH MICHIGAN AVENUE KENILWORTH, NEW JERSEY 07033	28520
STACKPOLE COMPONENTS COMPANY P.O. BOX 14466 RALEIGH, NORTH CAROLINA 27610	29604
PLASTIC PRINCE 1980 SOUTH ACOMA STREET DENVER, COLORADO 80223	29866
MURA CORPORATION 355 GREAT NECK ROAD GREAT NECK, NEW YORK 11021	32539
TRANEX INCORPORATED COLORADO SPRINGS DIVISION 2527 WESTON ROAD COLORADO SPRINGS, COLORADO 80910	34535
SPRAGUE ELECTRIC COMPANY NORTH ADAMS, MASSACHUSETTS 01247	56289
ATLANTIC INDIA RUBBER WORKS INC. 571 WEST POLK STREET CHICAGO, ILLINOIS 60607	70485
BROWNING MANUFACTURING CO. INC. MAIN AND CHESTER STREETS MAYSVILLE, KENTUCKY 41056	71176
CAMBRIDGE THERMIONIC CORPORATION 445 CONCORD AVENUE CAMBRIDGE, MASSACHUSETTS 02138	71279
BUSSMANN MANUFACTURING DIV. OF MC GRAW & EDISON COMPANY 2536 UNIVERSITY STREET ST LOUIS, MISSOURI 63017	71400

NAME AND ADDRESS	CODE
CINCH MANUFACTURING COMPANY HOWARD B JONES DIVISION 1026 SOUTH HOMAN AVENUE CHICAGO, ILLINOIS 60624	71785
G.C. ELECTRONICS COMPANY DIVISION OF HYDROMETALS INC. 400 SOUTH WYMAN STREET ROCKFORD, ILLINOIS 61101	72653
ELASTIC STOP NUT DIV. OF AMERACE ESNA CORPORATION 2330 VAUXHALL ROAD UNION, NEW JERSEY 07083	72962
ERIE TECHNOLOGICAL PRODUCTS INC. 644 WEST 12TH STREET ERIE, PENNSYLVANIA 16512	72982
BECKMAN INSTRUMENTS INCORPORATED HELIPOT DIVISION 2500 HARBOR BOULEVARD FULLERTON, CALIFORNIA 92634	73138
AMPEREX ELECTRONIC CORPORATION 230 DUFFY AVENUE HICKSVILLE, L. I. NEW YORK 11801	73445
FEDERAL SCREW PRODUCTS INC. 3917 NORTH KENZIE AVENUE CHICAGO, ILLINOIS 60618	73734
IRC DIVISION OF TRW INC. 401 NORTH BROAD STREET PHILADELPHIA, PENNSYLVANIA 19108	75042
LITTLEFUSE INCORPORATED 800 EAST NORTHWEST HIGHWAY DES PLAINES, ILLINOIS 60016	75915
ILLINOIS TOOL WORKS INCORPORATED SHAKEPROOF DIVISION ST CHARLES ROAD ELGIN, ILLINOIS 60126	78189
WALDES KOHINOOR INCORPORATED 47-16 AUSTEL PLACE LONG ISLAND CITY, NEW YORK 11101	79136
ZIERICK MANUFACTURING COMPANY RADIO CIRCLE MT KISCO, NEW YORK 10549	79963
JOINT ELECTRONIC TYPE DESIGNATION SYSTEM	80058
ELECTRONIC INDUSTRIES ASSOCIATION	80131
SPRAGUE PRODUCTS COMPANY NORTH ADAMS, MASSACHUSETTS 01247	80183
WINCHESTER ELECTRONICS LITTON INDUSTRIES INCORPORATED MAIN STREET AND HILLSIDE AVENUE OAKVILLE, CONNECTICUT 06779	81312
MILITARY SPECIFICATIONS PROMULGATED BY STANDARDIZATION DIRECTORATE OF LOGISTIC SERVICES DSA	81349

NAME AND ADDRESS	CODE
NEW HAMPSHIRE BALL BEARINGS INC. PETERBOROUGH, NEW HAMPSHIRE 03458	83086
SERVOTEK PRODUCTS COMPANY 1086 GOFFLE ROAD HAWTHORNE, NEW JERSEY 07506	83555
ELECTRONIC DEVICES INCORPORATED 21 GRAY OAKS AVENUE YONKERS, NEW YORK 10710	83701
TRW CAPACITOR DIVISION 112 WEST FIRST STREET OGALLALA, NEBRASKA 69153	84411
LEE SPRING COMPANY INCORPORATED 30 MAIN STREET BROOKLYN, NEW YORK 11201	84830
RCA CORPORATION ELECTRONIC COMPONENTS 415 SOUTH 5TH STREET HARRISON, NEW JERSEY 07029	86684
STOCKER AND YALE INCORPORATED ROUTE 128 AND BRIMBLE AVENUE BEVERLY, MASSACHUSETTS 01915	90640
DALE ELECTRONICS INCORPORATED P.O. BOX 609 COLUMBUS, NEBRASKA 68601	91637
MILITARY STANDARDS PROMULGATED BY STANDARDIZATION DIVISION DIRECTORATE OF LOGISTIC SERVICES DSA	96906
RUBBER TECK INCORPORATED P.O. BOX 389 GARDENA, CALIFORNIA 90247	98159
INTERNATIONAL ELECTRONIC RESEARCH CORPORATION 135 WEST MAGNOLIA AVENUE BURBANK, CALIFORNIA 91502	98978
STM CORPORATION 2904 CHAPMAN STREET OAKLAND, CALIFORNIA 94601	99392
SYNTRONIC INSTRUMENTS INC. 100 INDUSTRIAL ADDISON, ILLINOIS 60101	99409

TABLE A. OPERATOR'S LEVEL RECOMMENDED SPARE PARTS LIST

Honeywell Part Number	Description	Manufacturer's Code	Manufacturer's Part Number / National Stock No.	Qty/ Equip	Spares	Usable On Code
16750231-025	FUSE, CARTRIDGE, 0.125 AMP, 250V, SLO BLO	71400	MDL-125	1	5	
16750231-029	FUSE, CARTRIDGE, 0.75 AMP, 250V. SLO BLO	71400	MDL-750	1	5	
16750231-031	FUSE, CARTRIDGE, 1.5 AMP, 250V, SLO BLO	71400	MDX1-5 5920-990-3116	1	5	
16775628-002	LAMP INCANDESCENT	81840	J90100-011	1	1	
16775628-004	LAMP, INCANDESCENT	28009		1	1	

TABLE B. BENCH LEVEL RECOMMENDED SPARE PARTS LIST

Honeywell Part Number	Description	Manufacturer's Code	Manufacturer's Part Number / National Stock No.	Qty/ Equip	Spares	Usable On Code
04040505-001	INTEGRATED CIRCUIT, OPERATIONAL AMPLIFIER	28009		15	2	
16200115-001	LAMP,FLUORESCENT	08805	F4T5CW 6240-00-295-2652	3	1	
16200450-001	BELT,POSITIVE DRIVE	71176	160XL013	1	1	
16737938-108	SEMICONDUCTOR DEVICE DIODE,ZENER	04713	1N4735A 5961-904-2020	1	1	
16737938-111	SEMICONDUCTOR DEVICE, DIODE	80131	1N4738A 5961-00-989-9522	1	1	
16737938-113	SEMICODUCTOR DEVICE, DIODE, ZENER	80131	1N4740A 5961-057-7859	1	1	
16738403-001	TRANSISTOR	80131	2N3766 5961-835-6138	2	1	
16738900-002	SEMICONDUCTOR DEVICE,DIODE	28009		2	1	
16750231-025	FUSE, CARTRIDGE, 0.125 AMP, 250V, SLO BLO	71400	MDL-125	1	5	
16750231-029	FUSE, CARTRIDGE, 0.75 AMP, 250V, SLO BLO	71400	MDL-750	1	5	
16750231-031	FUSE, CARTRIDGE, 1.5 AMP, 250V, SLO BLO	71400	MDX1-5 5920-990-3116	1	5	
16755588-022	BELT, POSITIVE DRIVE	71176	130XL025	1	1	
16756865-003	SEMICONDUCTOR DEVICE, DIODE	81349	1N4148	105	10	
16756961-002	SEMICONDUCTOR DEVICE, DIODE	04713	1N4002 5961-880-4783	6	1	
16756961-007	SEMICONDUCTOR DEVICE,DIODE	04713	1N4007 5961-018-9785	1	1	
16757931-001	SEMICONDUCTOR DEVICE, DIODE, ZENER	80131	1N821 5961-00-951-6375	1	1	
16758060-002	SEMICONDUCTOR DEVICE,DIODE	80131	1N1200A 5961-052-5138	1	1	
16759755-002	SEMICONDUCTOR DEVICE,DIODE	14936	W02	1	1	
16762172-001	TRANSISTOR	80131	2N3904	2	1	
16762172-002	TRANSISTOR	80131	2N3904 5961-892-8706	10	2	

TABLE B. BENCH LEVEL RECOMMENDED SPARE PARTS LIST (CONT'D)

Honeywell Part Number	Description	Manufacturer's Code	Manufacturer's Part Number / National Stock No.	Qty/ Equip	Spares	Usable On Code
16762173-002	TRANSISTOR	80131	2N3906 5961-931-0472	6	2	
16763169-001	TRANSISTOR	80131	2N3053 5961-985-9073	1	1	
16763169-002	TRANSISTOR	80131	2N3054 5961-761-9379	2	1	
16763169-006	TRANSISTOR	86684	2N6254	6	1	
16763229-001	PLUG, TIP	28009		2	2	
16763229-002	PLUG, TIP	28009		1	2	
16763333-103	INTEGRATED CIRCUIT,OPERATIONAL AMPLIFIER	18324	L709-1	1	1	
16765537-001	INTEGRATED CIRCUIT, DIFFERENTIAL COMPARATOR	07263	USB771039X 5962-241-0667	2	1	
16765537-021	INTEGRATED CIRCUIT COMPARATOR	27014	LM306H	1	1	
16765537-022	INTEGRATED CIRCUIT, DIFFERENTIAL COMPARATOR	27014	LM311H	1	1	
16765784-003	TRANSISTOR	80131	2N4314 5961-456-4794	2	1	
16766748-001	TRANSISTOR	04713	2N4918 5961-410-8882	1	1	
16766748-003	TRANSISTOR	04713	2N4920 5961-177-3577	1	1	
16766748-004	TRANSISTOR	04713	2N4921 5961-411-1310	2	1	
16766748-006	TRANSISTOR	04713	2N4923 5961-105-7636	1	1	
16766919-003	INTEGRATED CIRCUIT, FLIP FLOP	01295	SN7476N 5962-106-4285	10	2	
16770064-001	SEMICONDUCTOR DEVICE DIODE	83701	PB05	1	1	
16770064-002	SEMICONDUCTOR DEVICE,DIODE	83701	PB10	1	1	
16770480-013	INTEGRATED CIRCUIT,VOLTAGE REGULATOR	04713	MC1463R	1	1	
16770480-014	INTEGRATED CIRCUIT,VOLTAGE REGULATOR	04713	MC1469R	2	1	

TABLE B. BENCH LEVEL RECOMMENDED SPARE PARTS LIST (CONT'D)

Honeywell Part Number	Description	Manufacturer's Code	Manufacturer's Part Number / National Stock No.	Qty/ Equip	Spares	Usable On Code
16771177-002	INTEGRATED CIRCUIT, MONOSTABLE MULTIVIBRATOR	21989	U6A960159X	1	1	
16771316-302	CAPACITOR,FIXED,ELECTROLYTIC, 5200UF,+100/-10%,30VDC	06001	86F147E	2	1	
16771316-601	CAPACITOR, FIXED, ELECTROLYTIC, 950UF, +100/-10%, 75VDC	06001	86F173M 5910-109-0251	1	1	
16771316-604	CAPACITOR, FIXED, ELECTROLYTIC, 4500UF, +100/-10%, 75VDC	06001	86F176M	1	1	
16771548-001	INTEGRATED CIRCUIT,OPERATIONAL AMPLIFIER	27014	LM301AH	2	1	
16773485-001	SEMICONDUCTOR DEVICE, DIODE	27777	VS247	2	1	
16774066-012	SEMICONDUCTOR DEVICE, DIODE	04713	1N5232A	1	1	
16774066-036	SEMICONDUCTOR DEVICE, DIODE	04713	1N5256A	1	1	
16774066-114	SEMICONDUCTOR DEVICE, DIODE	04713	1N5234B	3	1	
16774066-115	SEMICONDUCTOR DEVICE, DIODE	04713	1N5235B 5961-103-1583	1	1	
16774066-137	SEMICONDUCTOR DEVICE, DIODE	04713	1N5257B	1	1	
16774077-002	SEMICONDUCTOR DEVICE,DIODE	14099	3SM4	2	1	
16774509-002	ELECTRON TUBE, CATHODE RAY, FIBEROPTIC	01852	10M140PT435MF0	1	1	
16774664-107	TRANSISTOR	27014	2N3958	2	1	
16775260-001	CIRCUIT CARD ASSEMBLY, GRID LINE GENERATOR	28009		1	1	
16775531-001	CIRCUIT CARD ASSEMBLY, +-12V POWER SUPPLY	28009		1	1	
16775592-005	CAPACITOR, FIXED, ELECTROLYTIC 6400UF, +100/-10%, 15VDC	99392	91C15JC643	1	1	
16775592-006	CAPACITOR, FIXED, ELECTROLYTIC, 9000UF, +100/-10%, 75VDC	99392	91C75JC93	1	1	
16775628-002	LAMP INCANDESCENT	81840	J90100-011	1	1	
16775628-004	LAMP, INCANDESCENT	28009		1	1	

TABLE 6. BENCH LEVEL RECOMMENDED SPARE PARTS LIST (CONT'D)

Honeywell Part Number	Description	Manufacturer's Code	Manufacturer's Part Number / National Stock No.	Qty/ Equip	Spares	Usable On Code
16775639-001	INTEGRATED CIRCUIT, MONOSTABLE MULTIVIBRATOR	01295	SN74121N	3	1	
16775733-001	INTEGRATED CIRCUIT, BUFFER	01295	SN75451P 5962-497-1587	2	1	
16775734-001	SEMICONDUCTOR DEVICE, DIODE ARRAY	86684	CA3039 5961-401-7768	2	1	
16775735-001	SEMICONDUCTOR DEVICE, DIODE	28480	5082-2800 5961-00-492-7113	2	1	
16775735-101	SEMICONDUCTOR DEVICE, DIODE	28480	5082-2900 5961-110-7491	2	1	
16775737-001	INTEGRATED CIRCUIT, VOLTAGE REGULATOR	04713	MC1466L	1	1	
16776056-001	CIRCUIT CARD ASSEMBLY, SERVO CURRENT LIMITER	28009		1	1	
16776086-005	CIRCUIT CARD ASSEMBLY, CLOCK	28009		1	1	
16776247-001	INTEGRATED CIRCUIT, OPERATIONAL AMPLIFIER	04713	MC1456G	1	1	
16776278-001	KEY, POLARIZING	00779	583532-1	36	8	
16776363-001	SEMICONDUCTOR DEVICE, DIODE	14099	S2F	1	1	
16776363-002	SEMICONDUCTOR DEVICE, DIODE	14099	S4F	2	1	
16776365-001	SEMICONDUCTOR DEVICE, DIODE	27777	MH911H02	1	1	
16776367-001	TRANSISTOR	04713	MPS3640 5961-946-6635	24	3	
16776368-001	INTEGRATED CIRCUIT, LOGIC GATE	01295	SN74H01N	6	2	
16776369-001	INTEGRATED CIRCUIT, LOGIC GATE	01295	SN74H04N 5962-139-2849	1	1	
16776369-011	INTEGRATED CIRCUIT, LOGIC GATE	01295	SN74H05N	1	1	
16776979-001	TRANSISTOR	04713	MPSA17-5	1	1	
16778668-001	TRANSISTOR	04713	MPSA05-5	1	1	
16778916-001	CIRCUIT CARD ASSEMBLY, HIGH VOLTAGE	28009		1	1	

TABLE B. BENCH LEVEL RECOMMENDED SPARE PARTS LIST (CONT'D)

Honeywell Part Number	Description	Manufacturer's Code	Manufacturer's Part Number / National Stock No.	Qty/ Equip	Spares	Usable On Code
16779202-001	TRANSISTOR	04713	2N2369A	6	2	
16779424-002	CIRCUIT CARD ASSEMBLY, VIDEO	28009		1	1	
16779716-008	CIRCUIT CARD ASSEMBLY, SERVO	28009		1	1	
16783186-001	TRANSISTOR	04713	SJ7315	1	1	
16809449-001	CIRCUIT CARD ASSEMBLY, +40V AND +5V POWER SUPPY	28009		1	1	
99000000-001	MICROCIRCUIT	01295	SN7400N8	5	1	
99000004-001	INTEGRATED CIRCUIT,HEX INVERTER	01295	SN7404N 5962-404-2259	1	1	
99000010-001	INTEGRATED CIRCUIT,LOGIC GATE	01295	SN7410N 5962-865-4626	4	1	
99000013-001	INTEGRATED CIRCUIT, LOGIC GATE	01295	SN7440N 5962-185-3806	1	1	
99000019-001	INTEGRATED CIRCUIT,COUNTER,HIGH SPEED	01295	SN7493N 5962-684-8336	2	1	
99000409-001	TRANSISTOR	80131	2N3737 5961-00-011-7018	1	1	
	TIME LINE OPTION (SPARES LISTED BELOW)					
16756865-003	SEMICONDUCTOR DEVICE, DIODE	81349	1N4148	4	1	
16761780-002	TRANSISTOR	80131	2N3391 5961-931-0152	1	1	
16762172-002	TRANSISTOR	80131	2N3904 5961-892-8706	5	1	
16762173-002	TRANSISTOR	80131	2N3906 5961-931-0472	1	1	
16771548-001	INTEGRATED CIRCUIT,OPERATIONAL AMPLIFIER	27014	LM301AH	1	1	
16775376-001	INTEGRATED CIRCUIT, SHIFT REGISTER	01295	SN7496N-00	2	1	
16775377-001	INTEGRATED CIRCUIT, MONOSTABLE MULTIVIBRATOR	01295	SN74123N	2	1	
16776089-002	CIRCUIT CARD ASSEMBLY, TIME LINE	28009		1	1	

TABLE B. BENCH LEVEL RECOMMENDED SPARE PARTS LIST (CONT'D)

Honeywell Part Number	Description	Manufacturer's Code	Manufacturer's Part Number / National Stock No.	Qty/ Equip	Spares	Usable On Code
99000000-001	MICROCIRCUIT	01295	SN7400N8	8	2	
99000008-001	INTEGRATED CIRCUIT, LOGIC GATE	01295	SN7408N	2	1	
99000010-001	INTEGRATED CIRCUIT,LOGIC GATE	01295	SN7410N 5962-865-4626	3	1	
99000013-001	INTEGRATED CIRCUIT, LOGIC GATE	01295	SN7440N 5962-185-3806	1	1	
99000018-001	INTEGRATED CIRCUIT,COUNTER,HIGH SPEED	01295	SN7490N 5962-102-7519	7	2	
	TRACE IDENTIFIER OPTION (SPARES LISTED BELOW)					
16756865-003	SEMICONDUCTOR DEVICE, DIODE	81349	1N4148	2	1	
16763229-001	PLUG, TIP	28009		1	2	
16765537-001	INTEGRATED CIRCUIT, DIFFERENTIAL COMPARATOR	07263	U5B771039X 5962-241-0667	1	1	
16766919-003	INTEGRATED CIRCUIT, FLIP FLOP	01295	SN7476N 5962-106-4285	2	1	
16775376-001	INTEGRATED CIRCUIT, SHIFT REGISTER	01295	SN7496N-00	1	1	
16775732-001	INTEGRATED CIRCUIT, DECODER	01295	SN7442N-00	1	1	
16776155-001	INTEGRATED CIRCUIT, LOGIC GATE	01295	SN74S00N	2	1	
16776368-001	INTEGRATED CIRCUIT, LOGIC GATE	01295	SN74H01N	7	2	
16776698-002	INTEGRATED CIRCUIT, BUFFER	01295	SN74S40N	1	1	
16778119-001	INTEGRATED CIRCUIT, DECODER/ DRIVER	01295	SN7447AN	2	1	
16779202-001	TRANSISTOR	04713	2N2369A	1	1	
16779427-001	INTEGRATED CIRCUIT, SHIFT REGISTER	01295	SN74164N	1	1	
16779478-001	INTEGRATED CIRCUIT, VOLTAGE COMPARATOR, DUAL	18324	NE 521A	1	1	
16779569-001	CIRCUIT CARD ASSEMBLY, 32-CHANNEL TRACE IDENTIFIER	28009		1	1	

TABLE B. BENCH LEVEL RECOMMENDED SPARE PARTS LIST (CONT'D)

Honeywell Part Number	Description	Manufacturer's Code	Manufacturer's Part Number / National Stock No.	Qty/ Equip	Spares	Usable On Code
30731648-001	INTEGRATED CIRCUIT, LOGIC GATE	28009		1	1	
99000004-001	INTEGRATED CIRCUIT,HEX INVERTER	01295	SN7404N 5962-404-2259	3	1	
99000008-001	INTEGRATED CIRCUIT, LOGIC GATE	01295	SN7408N	1	1	
99000010-001	INTEGRATED CIRCUIT,LOGIC GATE	01295	SN7410N 5962-865-4626	2	1	
99000018-001	INTEGRATED CIRCUIT,COUNTER,HIGH SPEED	01295	SN7490N 5962-102-7519	2	1	
99000184-001	INTEGRATED CIRCUIT, LOGIC GATE	28009		2	1	
	TAKE-UP OPTION (SPARES LISTED BELOW)					
16755588-025	BELT, POSITIVE DRIVE	71176	70XL012	1	1	

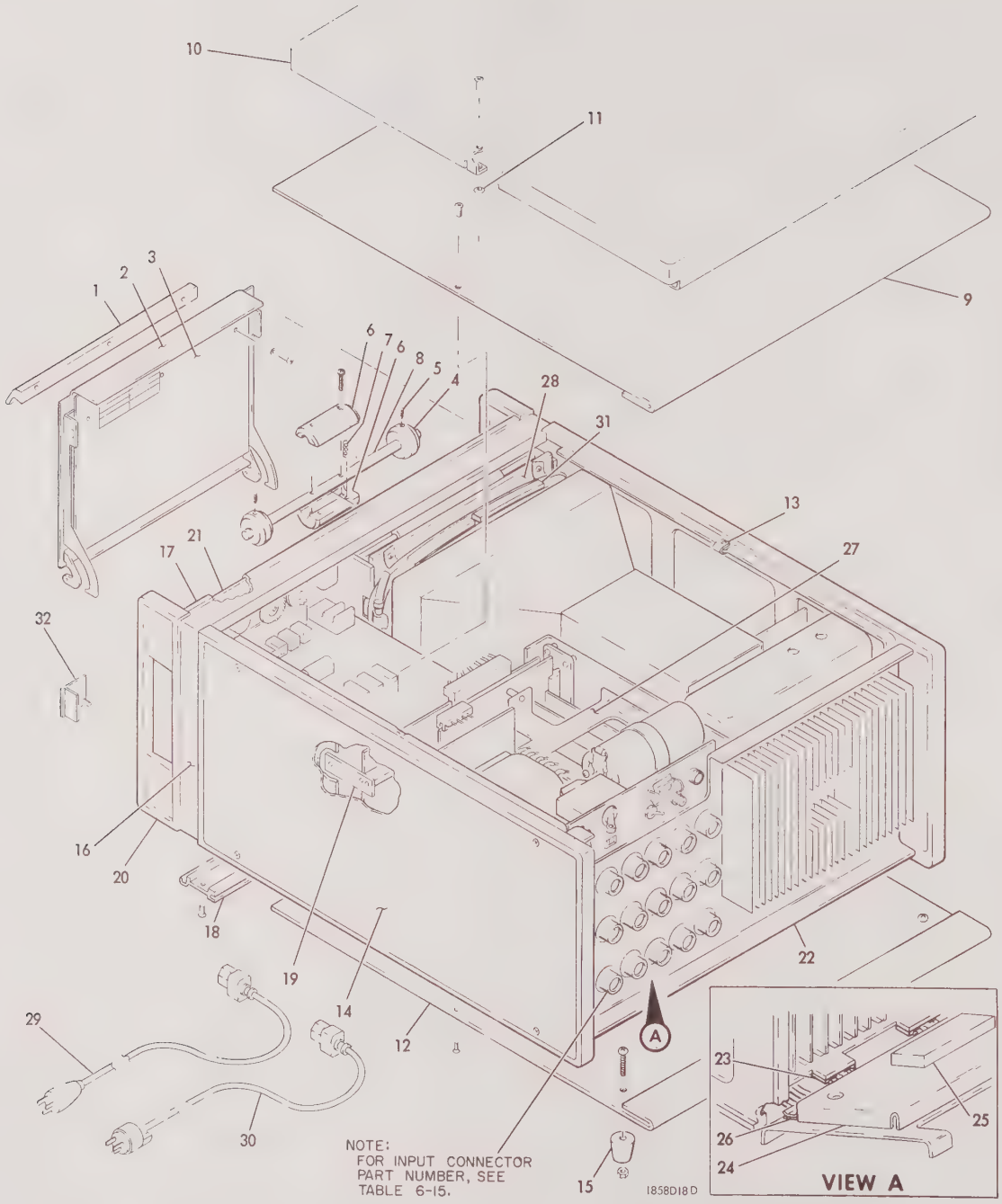


FIGURE 6-1. 1858 OSCILLOGRAPH FINAL ASSEMBLY

TABLE 6-1. 1858 OSCILLOGRAPH FINAL ASSEMBLY (SHEET 1 OF 2)

FIGURE NUMBER	INDEX NUMBER	REFERENCE DESIGNATOR	DESCRIPTION 1 2 3 4 5 6 7	MANUFACTURER'S CODE	MANUFACTURER'S PART NUMBER / FEDERAL STOCK NUMBER	HONEYWELL PART NUMBER	QUANTITY PER ASSEMBLY	USABLE ON CODE	NOTES
6-1			1858 OSCILLOGRAPH FINAL ASSEMBLY	28009		16781207-000	REF		
6-1			. DOOR, ACCESS, PAPER DRIVE	28009		16776138-002	1		
6-1	1		. . HANDLE, HOOK, PAPER DRIVE ACCESS DOOR	28009		16775989-001	1		
6-1	2		. . DOOR ASSEMBLY	28009		16775996-001	1		
6-1	3		. . PLATE, INSTRUCTION, PAPER LOADING	28009		16776139-002	1		
6-1			. SPINDLE ASSEMBLY, SUPPLY	28009		16778789-001	1		
6-1	4		. . END FITTING, SPINDLE, PAPER SUPPLY	28009		16778792-001	2		
6-1	5		. . SETSCREW,HEX DH,CUP POINT,CRES, NO.8-32NC2A BY 0.250 IN. LG	28009	COML	16750044-035	2		
6-1	6		. . BRAKE SHOE, SPINDLE, PAPER SUPPLY	28009		16778791-001	2		
6-1	7		. . SPRING,HELICAL,COMPRESSION, SS, 0.180 IN. OD BY 0.375 IN. LG	84830	LC018B3	16738289-006	4		
6-1	8		. . SHAFT, SPINDLE, PAPER SUPPLY	28009		16778790-002	1		
6-1	9		. COVER, TOP / BOTTOM	28009		16775897-001	1		1
6-1	10		. SHROUD, TOP	28009		16781106-001	1		2
6-1	11		. "O" RING,	86579	006	16726367-010	2		
6-1	12		. COVER, TOP / BOTTOM	28009		16775897-001	1		
6-1	13		. NUT, SPRING	78553	C11351-632-27	16759421-036	4		
6-1	14		. COVER, SIDE, SLIDE MOUNTING	28009		16775925-002	2		
6-1	15		. BUMPER, RUBBER	70485	1743	16750478-004	4		
6-1	16		. TRIM BAND (BLACK)	28009		16501849-003	AR		
6-1	17		. TRIM, PANEL MOUNTING	28009		16766886-001	1		
6-1	18		. TRIM, PANEL MOUNTING	28009		16775893-001	1		
6-1	19		. PLATE, TIE DOWN	28009		16775884-001	1		
6-1	20		. FRAME, SIDE	28009		16778806-001	2		
6-1	21	A1	. PANEL ASSEMBLY, FRONT (SEE TABLE 6-2 FOR BREAKDOWN)	28009		16776057-005	1		
6-1	22	A2	. PANEL ASSEMBLY, REAR (SEE TABLE 6-3 FOR BREAKDOWN)	28009		16776020-003	1		
6-1	23		. SPACER	28009		16776110-002	3		
6-1	24		. SHIELD, CONNECTOR ELECTICAL	28009		16776017-003	1		
6-1	25		. TAPE, PRESSURE SENSITIVE, 0.5IN. THK. X 1.0IN.W.	87730		16764281-063	AR		
6-1	26		. TAPE, PRESURE SENSITIVE, 1/8 IN. THK. X 3/8 IN. WIDE	28009		16737958-033	AR		
6-1	27	A3	. ELECTRONICS CHASSIS ASSEMBLY (REQUIRED FOR MODEL 1870 COMPATIBILITY) (SEE TABLE 6-4 FOR BREAKDOWN)	28009		16779913-003	1		
6-1	27	A3	. ELECTRONICS CHASSIS ASSEMBLY (WITHOUT 1870 COMPATIBILITY) (SEE TABLE 6-4 FOR BREAKDOWN)	28009		16779913-004	1		

NOTES:
1. USED ON INDUSTRIAL MACHINE ONLY
2. USED ON MEDICAL MACHINE ONLY

TABLE 6-1. 1858 OSCILLOGRAPH FINAL ASSEMBLY (SHEET 2 OF 2)

FIGURE NUMBER	INDEX NUMBER	REFERENCE DESIGNATOR	DESCRIPTION 1 2 3 4 5 6 7	MANUFACTURER'S CODE	MANUFACTURER'S PART NUMBER / FEDERAL STOCK NUMBER	HONEYWELL PART NUMBER	QUANTITY PER ASSEMBLY	USABLE ON CODE	NOTES
6-1	28	A4	. PAPER DRIVE ASSEMBLY (WITH TAKE-UP)	28009		16779871-007	1		
			(SEE TABLE 6-5 FOR BREAKDOWN)						
6-1	28	A4	. PAPER DRIVE ASSEMBLY (WITHOUT TAKE-UP)	28009		16779871-008	1		
			(SEE TABLE 6-5 FOR BREAKDOWN)						
6-1	29	W1	. POWER CORD	28009		16738632-011	1		1
6-1	30	W1	. POWER CORD, ASSEMBLY	28009		16781184-001	1		2
6-1	31		. MAGNET, PERMANENT, PLASTIC	28009		16778863-001	AR		
6-1	32		. BLANK COVER ASSEMBLY, PLUG IN MODULE	28009		16776257-001	AR		
6-1			. PAPER, PHOTO SENSITIVE	28009		16774562-810	1		
6-1			LATENSIFIER ASSEMBLY	28009		16775753-003	AR		
			(SEE TABLE 6-18 FOR BREAKDOWN)						
6-1			PLATEN ASSEMBLY, REFERENCE	28009		16778736-001	AR		
			(SEE TABLE 6-19 FOR BREAKDOWN)						
6-1			KIT, RACK MOUNTING, UNITS WITH SLIDE MOUNTING COVER	28009		16776101-002	AR		
			(SEE TABLE 6-20 FOR BREAKDOWN)						
6-1			SERVICE KIT, 1858 VISICORDER	28009		16776102-002	AR		
			(SEE TABLE 6-21 FOR BREAKDOWN)						

NOTES
1. USED ON INDUSTRIAL MACHINE ONLY.
2. USED ON MEDICAL MACHINE ONLY.

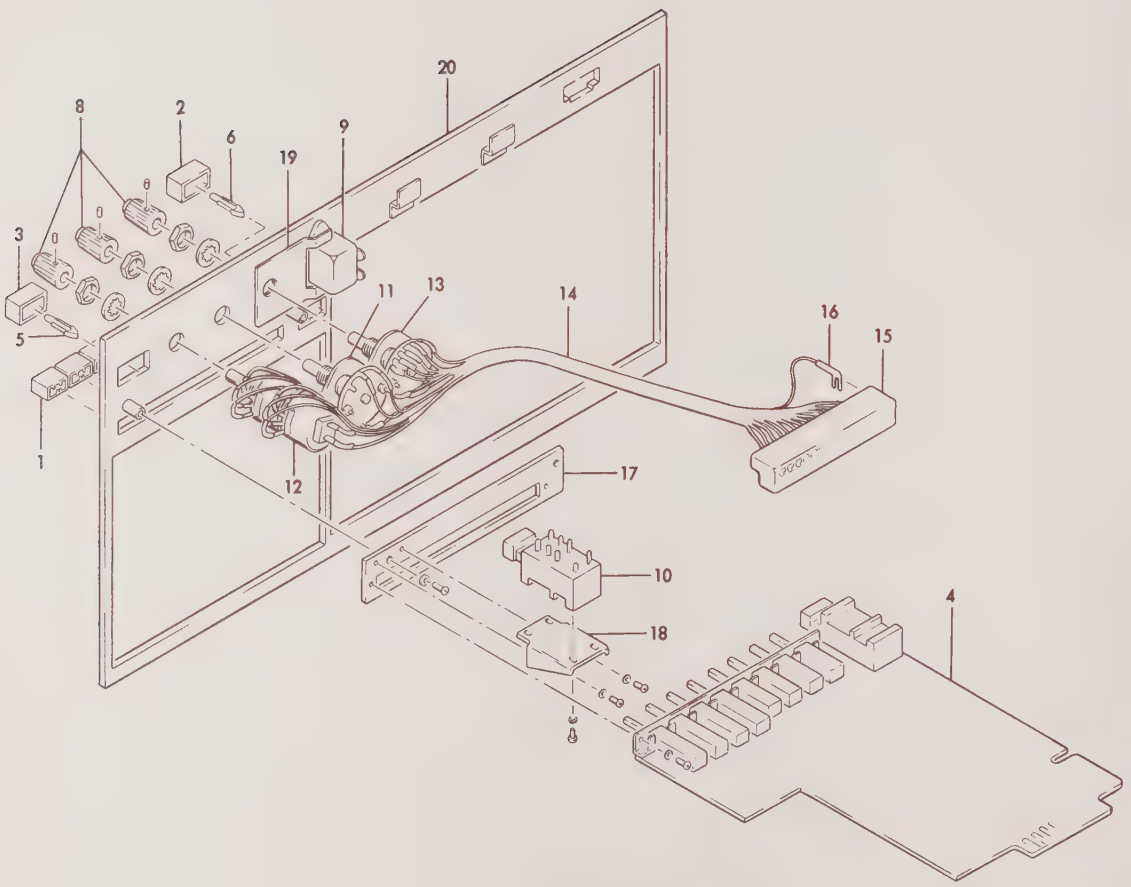


FIGURE 6-2. FRONT PANEL ASSEMBLY

TABLE 6-2. FRONT PANEL ASSEMBLY

FIGURE NUMBER	INDEX NUMBER	REFERENCE DESIGNATOR	DESCRIPTION 1 2 3 4 5 6 7	MANUFACTURER'S CODE	MANUFACTURER'S PART NUMBER / FEDERAL STOCK NUMBER	HONEYWELL PART NUMBER	QUANTITY PER ASSEMBLY	USABLE ON CODE	NOTES
6-2		A1	PANEL ASSEMBLY, FRONT (SEE TABLE 6-1 FOR LOCATION IN NHA)	28009		16776057-005	REF		
6-2	1		. BUTTON CAP, SWITCH	28009		16775335-901	8		
6-2	2		. BUTTON CAP, SWITCH	81840	L49273-004-15	16775411-102	1		
6-2	3		. BUTTON CAP, SWITCH	81840	L49273-004-13	16775411-101	1		
6-2	4	A1	. CIRCUIT CARD ASSEMBLY, SERVO (SEE TABLE 6-6 FOR BREAKDOWN)	28009		16779716-008	1		
6-2	5	DS1	. LAMP, INCANDESCENT	28009		16775628-004	1		
6-2	6	DS2	. LAMP INCANDESCENT	81840	J90100-011	16775628-002	1		
	7		. NOT USED						
6-2	8		. KNOB, CONTROL	21604	PS50DL1BLK	16757252-403	3		
6-2	9	M1	. METER, ELECTRICAL, PAPER SUPPLY INDICATOR	32539	TE-10	16775919-001	1		
6-2	10	S1	. SWITCH, PUSH, ILLUMINATED	81840	J15101-101	16775411-001	1		
6-2	11	S2	. SWITCH, ROTARY	28009		16775412-002	1		
6-2	12	S3/R1	. RESISTOR, VARIABLE, TANDEM, 5K OHMS FRONT, 50K OHMS REAR, +-5%	28009		16779391-001	1		
6-2	13	S4	. SWITCH, ROTARY	28009		16775412-003	1		
6-2	14	W1	. WIRING HARNESS, CONTROL	28009		16776058-002	1		
6-2	15	W1P1	. . CONNECTOR, RECEPTACLE	00779	582378-9 5935-402-7296	16776053-008	1		
6-2	16		. . CONTACT, ELECTRICAL CONNECTOR	00779	583380-3	16776053-101	16		
6-2	17		. SUB-PANEL, SWITCH MOUNTING	28009		16775891-001	1		
6-2	18		. BRACKET, SWITCH MOUNTING	28009		16775881-001	1		
6-2	19		. BRACKET, METER HOLD DOWN	28009		16775904-001	1		
6-2	20		. PANEL, FRONT	28009		16775892-004	1		

NOTES:

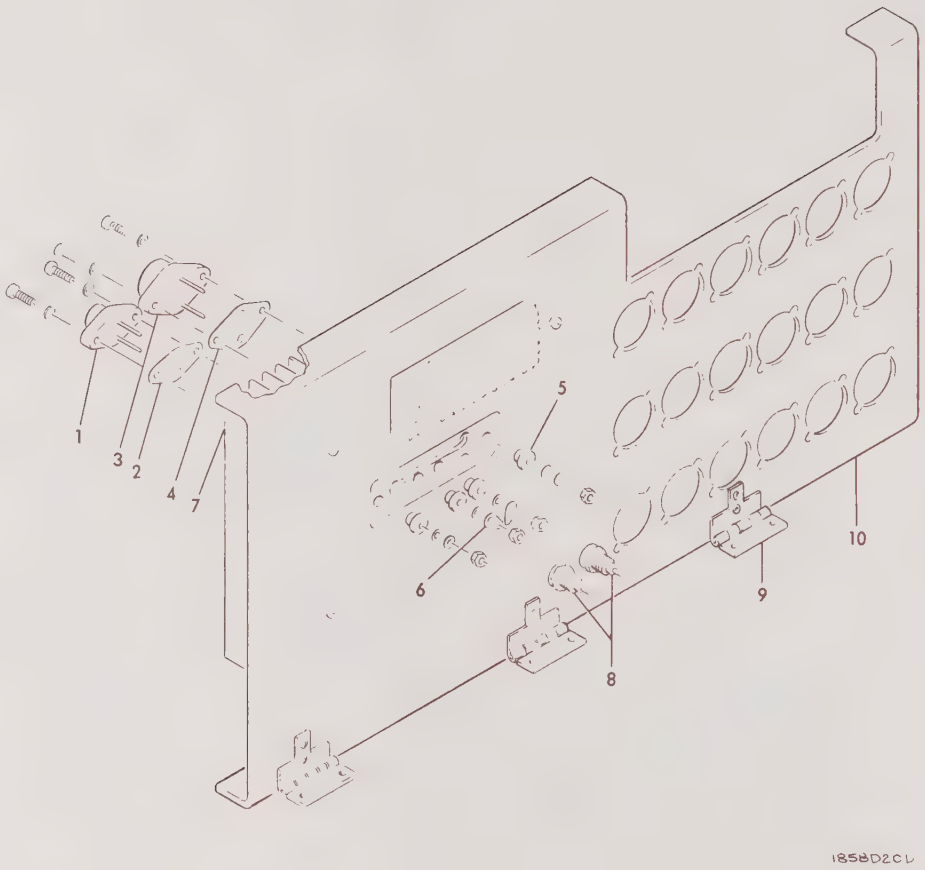
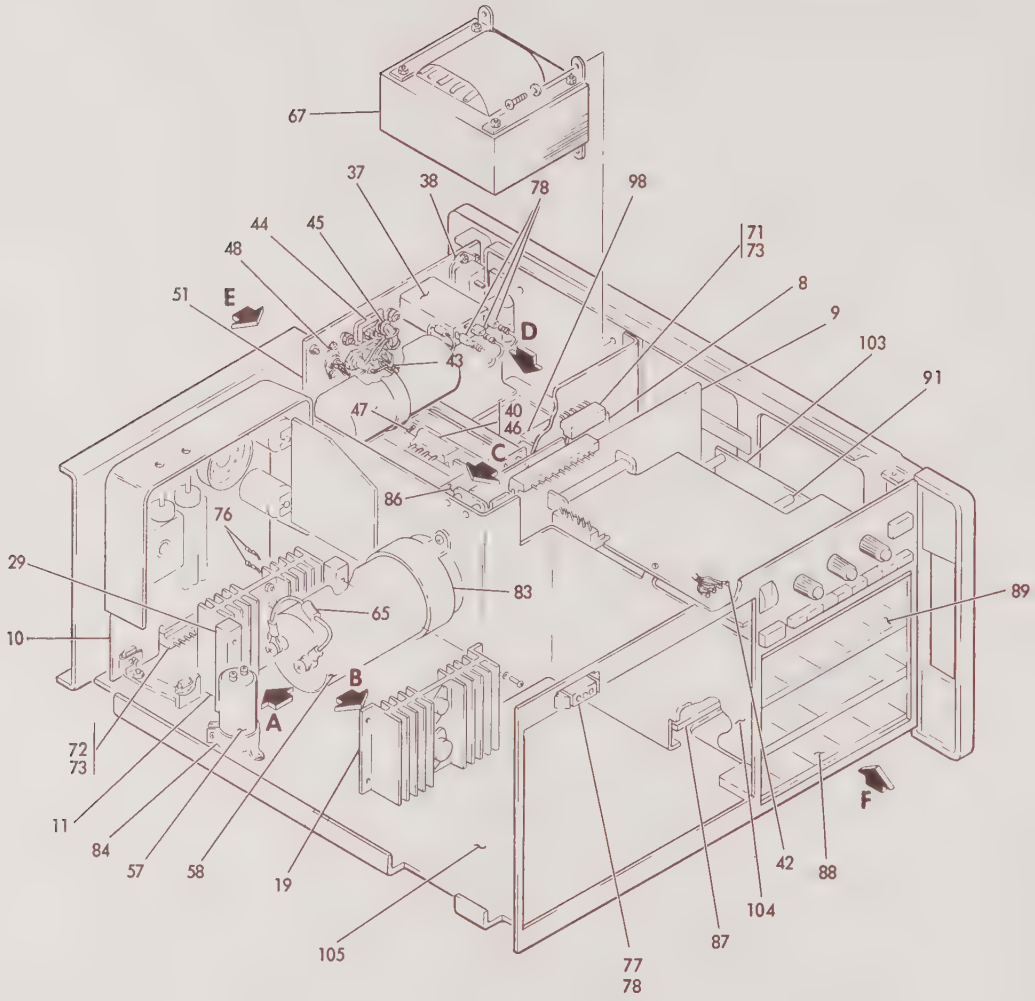


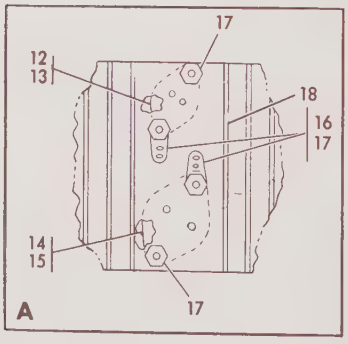
FIGURE 6-3. REAR PANEL ASSEMBLY

TABLE 6-3. REAR PANEL ASSEMBLY

FIGURE NUMBER	INDEX NUMBER	REFERENCE DESIGNATOR	DESCRIPTION 1 2 3 4 5 6 7	MANUFACTURER'S CODE	MANUFACTURER'S PART NUMBER / FEDERAL STOCK NUMBER	HONEYWELL PART NUMBER	QUANTITY PER ASSEMBLY	USABLE ON CODE	NOTES
6-3		A2	PANEL ASSEMBLY, REAR (SEE TABLE 6-1 FOR LOCATION IN NHA)	28009		16776020-003	REF		
6-3		A1	. COMPONENT ASSEMBLY, ELECTRONIC, HEATSINK MOUNTED	28009		16776075-002	1		
6-3	1	Q1	. . TRANSISTOR	80131	2N3054 5961-761-9379	16763169-002	1		
6-3	2		. . INSULATOR, PLATE	13103	56-03-2AP	16784833-001	1		
6-3	3	Q2	. . TRANSISTOR	86684	2N6254	16763169-006	1		
6-3	4		. . INSULATOR, PLATE	13103	56-66-2AP	16784833-002	1		
6-3	5		. . WASHER, SHOULDER, NYLON	28009		16757313-010	4		
6-3	6		. . TERMINAL,LUG	79963	505 5940-058-4543	16750161-006	2		
6-3	7		. . HEATSINK, POWER SUPPLY	28009		16775905-002	1		
6-3		J1-J18	. NOT USED						
6-3	8	J19,J20	. CONNECTOR, RECEPTACLE, ELECTRICAL COAXIAL	80058	UG1094AU	16737992-001	2		
6-3	9		. HINGE, BUTT	28009		16778889-001	3		
6-3	10		. PANEL, REAR	28009		16775907-003	1		

NOTES





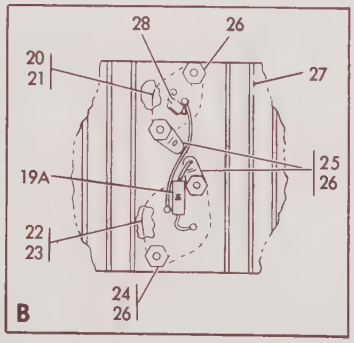


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FIGURE 6-4. ELECTRONICS CHASSIS ASSEMBLY (SHEET 1 OF 2)

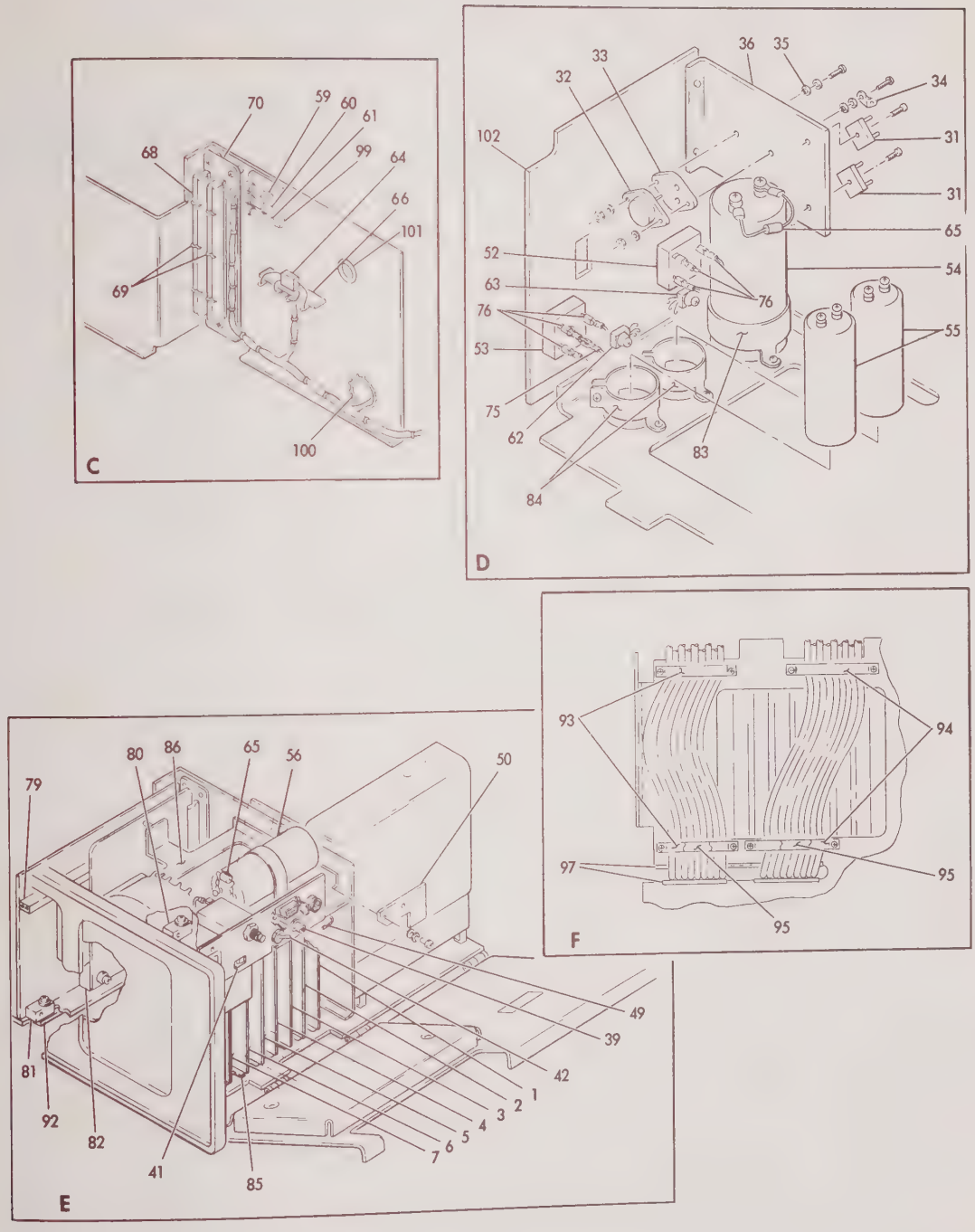

FIGURE 6-4. ELECTRONICS CHASSIS ASSEMBLY (SHEET 2 OF 2)

TABLE 6-4. ELECTRONICS CHASSIS ASSEMBLY (SHEET 1 OF 5)

FIGURE NUMBER	INDEX NUMBER	REFERENCE DESIGNATOR	DESCRIPTION 1 2 3 4 5 6 7	MANUFACTURER'S CODE	MANUFACTURER'S PART NUMBER / FEDERAL STOCK NUMBER	HONEYWELL PART NUMBER	QUANTITY PER ASSEMBLY	USABLE ON CODE	NOTES
6-4		A3	ELECTRONICS CHASSIS ASSEMBLY (REQUIRED FOR MODEL 1870 COMPATIBILITY) (SEE TABLE 6-1 FOR LOCATION IN NHA)	28009		16779913-003	REF	A	
6-4		A3	ELECTRONICS CHASSIS ASSEMBLY (WITHOUT 1870 COMPATIBILITY) (SEE TABLE 6-1 FOR LOCATION IN NHA)	28009		16779913-004	REF	B	
6-4	1	A1	• CIRCUIT CARD ASSEMBLY, VIDEO (SEE TABLE 6-7 FOR BREAKDOWN)	28009		16779424-002	1		
6-4	2	A2	• CIRCUIT CARD ASSEMBLY, 32-CHANNEL TRACE IDENTIFIER (SEE TABLE 6-8 FOR BREAKDOWN)	28009		16779569-001	1		
6-4	3	A3	• CIRCUIT CARD ASSEMBLY, CLOCK (SEE TABLE 6-9 FOR BREAKDOWN)	28009		16776086-005	1		
6-4	4	A4	• CIRCUIT CARD ASSEMBLY, GRID LINE GENERATOR (SEE TABLE 6-10 FOR BREAKDOWN)	28009		16775260-001	1		
6-4	5	A5	• CIRCUIT CARD ASSEMBLY, TIME LINE (SEE TABLE 6-11 FOR BREAKDOWN)	28009		16776089-002	1		
6-4	6	A6	• CIRCUIT CARD ASSEMBLY, +40V AND +5V POWER SUPPLY (SEE TABLE 6-12 FOR BREAKDOWN)	28009		16809449-001	1		
6-4	7	A7	• CIRCUIT CARD ASSEMBLY, +-12V POWER SUPPLY (SEE TABLE 6-13 FOR BREAKDOWN)	28009		16775531-001	1		
6-4	8	A8	• CIRCUIT CARD ASSEMBLY, ELECTRICAL INTERCONNECT, REAR (SEE TABLE 6-14 FOR BREAKDOWN)	28009		16776080-002	1		
6-4	9	A9	• CIRCUIT CARD ASSEMBLY, ELECTRICAL INTERCONNECT, FRONT (SEE TABLE 6-15 FOR BREAKDOWN)	28009		16776077-001	1		
		A10	• NOT USED						
6-4	10	A11	• CIRCUIT CARD ASSEMBLY, HIGH VOLTAGE (SEE TABLE 6-16 FOR BREAKDOWN)	28009		16778916-001	1		
6-4		A12	• COMPONENT ASSEMBLY, ELECTRONIC, HEAT SINK MOUNTED	28009		16776062-006	1		
6-4	11	A1	• • COMPONENT ASSEMBLY, ELECTRONIC, HEAT SINK MOUNTED	28009		16776062-004	1		
6-4	12	Q1	• • • TRANSISTOR	80131	2N3766 5961-835-6138	16738403-001	1		
6-4	13		• • • INSULATOR, PLATE	13103	56-66-2AP	16784833-002	1		
6-4	14	Q2	• • • TRANSISTOR	04713	SJ7315	16783186-001	1		
6-4	15		• • • INSULATOR, PLATE	13103	56-03-2AP	16784833-001	1		
6-4	16		• • • TERMINAL, LUG	79963	505 5940-058-4543	16750161-006	2		

NOTES:

TABLE 6-4. ELECTRONICS CHASSIS ASSEMBLY (SHEET 2 OF 5)

FIGURE NUMBER	INDEX NUMBER	REFERENCE DESIGNATOR	DESCRIPTION 1 2 3 4 5 6 7	MANUFACTURER'S CODE	MANUFACTURER'S PART NUMBER / FEDERAL STOCK NUMBER	HONEYWELL PART NUMBER	QUANTITY PER ASSEMBLY	USABLE ON CODE	NOTES
6-4	17		. . . WASHER, SHOULDER, NYLON	28009		16757313-010	4		
6-4	18		. . . HEATSINK, TRANSISTOR	28009		16775899-002	1		
6-4	19	A2	. . COMPONENT ASSEMBLY, ELECTRONIC, HEAT SINK MOUNTED	28009		16776062-005	1		
6-4	19A	CR1	. . . SEMICONDUCTOR DEVICE, DIODE	04713	1N4002 5961-880-4783	16756961-002	1		
6-4	20	Q1	. . . TRANSISTOR	80131	2N3054 5961-761-9379	16763169-002	1		
6-4	21		. . . INSULATOR, PLATE	13103	56-66-2AP	16784833-002	1		
6-4	22	Q2	. . . TRANSISTOR	86684	2N6254	16763169-006	1		
6-4	23		. . . INSULATOR, PLATE	13103	56-03-2AP	16784833-001	1		
6-4	24		. . . TERMINAL, INSULATED (STANDOFF)	71279	3648-2	16750202-001	1		
6-4	25		. . . TERMINAL,LUG	79963	505 5940-058-4543	16750161-006	2		
6-4	26		. . . WASHER, SHOULDER, NYLON	28009		16757313-010	4		
6-4	27		. . . HEATSINK, TRANSISTOR	28009		16775899-002	1		
6-4		C1	. . NOT USED						
6-4	28	C2	. . CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.01UF, +-20%, 50VDC	72982	8121-050-651-103M	16771020-011	1		
6-4	29		. . BAR, PLASTIC	28009		16775902-001	2		
6-4	30		. . CONTACT, ELECTRICAL CONNECTOR	00779	66088-3	16776053-102	8		
6-4		A13	. NOT USED						
6-4		A14	. COMPONENT ASSEMBLY, ELECTRONIC BRACKET MOUNTED	28009		16776063-001	1		
6-4	31	CR1,CR2	. . SEMICONDUCTOR DEVICE, DIODE	27777	VS247	16773485-001	2		
6-4	32	Q1	. . TRANSISTOR	86684	2N6254	16763169-006	1		
6-4	33		. . INSULATOR, PLATE	00779	87605-1	16784833-001	1		
6-4	34		. . TERMINAL,LUG	79963	505 5940-058-4543	16750161-006	1		
6-4	35		. . WASHER, SHOULDER, NYLON	73734	105101 5310-458-2023	16757313-002	2		
6-4	36		. . BRACKET, ANGLE, COMPONET MOUNTING	28009		16775900-001	1		
6-4		A15	. SUBPANEL ASSEMBLY, REAR	28009		16781109-003	1	A	
6-4		A15	. SUBPANEL ASSEMBLY, REAR (REQUIRED FOR MODEL 1870 COMPATIBILITY)	28009		16781109-004	1	B	
6-4	37	CB1	. . CIRCUIT BREAKER, 1.5 AMP	06402	45-700P-A3	16783561-002	1		
6-4	38	J1	. . CONNECTOR, RECEPTICAL, ELECTRICAL	82389	EAC-301	16750130-019	1		
6-4	39	J2	. . CONNECTOR, RECEPTACLE, ELECTRICAL COAXIAL	80058	UG1094AU	16737992-001	1		
6-4	40	P1	. . CONNECTOR, RECEPTACLE, ELECTRICAL	00779	582376-9	16776053-005	1	A	
6-4	41	S1	. . SWITCH, SLIDE, DPDT, BLACK	82398	46256LFR	16765838-301	1		
6-4	42	S2	. . SWITCH,TOGGLE,MINIATURE	91929	2TM1T2 5930-725-3708	16757884-002	1		
6-4		W1	. . CABLE ASSEMBLY, REMOTE CONTROL, PAPER DRIVE	28009		16779774-001	1		

NOTES:

TABLE 6-4. ELECTRONICS CHASSIS ASSEMBLY (SHEET 3 OF 5)

FIGURE NUMBER	INDEX NUMBER	REFERENCE DESIGNATOR	DESCRIPTION 1 2 3 4 5 6 7	MANUFACTURER'S CODE	MANUFACTURER'S PART NUMBER / FEDERAL STOCK NUMBER	HONEYWELL PART NUMBER	QUANTITY PER ASSEMBLY	USABLE ON CODE	NOTES
6-4	43		• • • TERMINAL, QUICK DISCONNECT	00779	61513-1	16767598-021	4		
6-4		W2	• • CABLE ASSEMBLY, SPECIAL PURPOSE, ELECTRICAL (SIGNAL)	28009		16779741-001	1	A	
6-4	44	J1	• • • CONNECTOR,RECEPTACLE,14 PIN	02660	57-40140 5935-648-3298	16750110-012	1		
6-4	45	T1	• • • CORE,TRANSFORMER	78488	57-0981	16778073-001	1		
6-4	46		• • • CONTACT, ELECTRICAL CONNECTOR	00779	66088-3	16776053-102	12		
6-4	47		• • • TERMINAL, QUICK DISCONNECT	00779	60804-4	16767598-012	2		
6-4		W3	• • CABLE ASSEMBLY, SPECIAL PURPOSE, ELECTRICAL (VIDEO)	28009		16779742-001	1	A	
6-4	48	J1	• • • CONNECTOR, RECPTACLE, ELECTRICAL-ROUND, LOCKRING	82398	60HA4F	16779745-001	1		
6-4	49		• • • TERMINAL,QUICK DISCONNECT	00779	60598-5	16767598-011	3		
6-4	50		• • COVER, CONNECTOR HOLE	28009		16779685-001	1	B	
6-4	51		• • SUBPANEL, REAR	28009		16781105-002	1		
6-4	52	CR1	• SEMICONDUCTOR DEVICE DIODE	83701	PB05	16770064-001	1		
6-4	53	CR2	• SEMICONDUCTOR DEVICE,DIODE	83701	PB10	16770064-002	1		
6-4	54	C1	• CAPACITOR, FIXED, ELECTROLYTIC 6400UF, +100/-10%, 15VDC	99392	91C15JC643	16775592-005	1		
6-4	55	C2,C3	• CAPACITOR, FIXED, ELECTROLYTIC, 4000UF, +100/-10%, 30VDC	56289	36DX402G030AA2A	16761582-777	2		
6-4	56	C4	• CAPACITOR, FIXED, ELECTROLYTIC, 4500UF, +100/-10%, 75VDC	06001	86F176M	16771316-604	1		
6-4	57	C5	• CAPACITOR, FIXED, ELECTROLYTIC, 950UF, +100/-10%, 75VDC	06001	86F173M 5910-109-0251	16771316-601	1		
6-4	58	C6	• CAPACITOR, FIXED, ELECTROLYTIC, 9000UF, +100/-10%, 75VDC	99392	91C75JC93	16775592-006	1		
6-4	59	F1	• FUSE, CARTRIDGE, 1.5 AMP, 250V, SLO BLO	71400	MDX1-5 5920-990-3116	16750231-031	1		
6-4	60	F2	• FUSE, CARTRIDGE, 0.125 AMP, 250V, SLO BLO	71400	MDL-125	16750231-025	1		
6-4	61	F3	• FUSE, CARTRIDGE, 0.75 AMP, 250V, SLO BLO	71400	MDL-750	16750231-029	1		
6-4	62	Q1	• TRANSISTOR	04713	2N4921 5961-411-1310	16766748-004	1		
6-4	63	Q2	• TRANSISTOR	04713	2N4918 5961-410-8882	16766748-001	1		
6-4	64	R1	• SHUNT, INSTRUMENT	28009		16776383-001	1		
6-4	65	R2-R4	• RESISTOR, FIXED, CARBON COMPOSITION, 5.1K OHMS, +-5%, 2W	81349	RCR42G512JM	16750078-068	3		
6-4	66	TB1	• TERMINAL BOARD	71785	332-11-07-108	16750153-036	1		
6-4	67	T1	• TRANSFORMER, POWER	34535	14-6249	16779706-003	1		
6-4		W1	• CABLE ASSEMBLY, POWER, ELECTRICAL BRANCHED	28009		16781141-002	1		
6-4		A1	• • CIRCUIT CARD ASSEMBLY, INTERCONNECT, ELECTRICAL	28009		16776078-001	1		
6-4	68	J1,J2	• • • CONNECTOR, RECEPTACLE	00779	3-583407-8	16776276-238	2		
6-4	69		• • • KEY, POLARIZING	00779	583532-1	16776278-001	6		

NOTES

TABLE 6-4. ELECTRONICS CHASSIS ASSEMBLY (SHEET 4 OF 5)

FIGURE NUMBER	INDEX NUMBER	REFERENCE DESIGNATOR	DESCRIPTION 1 2 3 4 5 6 7	MANUFACTURER'S CODE	MANUFACTURER'S PART NUMBER / FEDERAL STOCK NUMBER	HONEYWELL PART NUMBER	QUANTITY PER ASSEMBLY	USABLE ON CODE	NOTES
6-4	70		. . . PRINTED WIRING BOARD, ELECTRICAL INTERCONNECT	28009		16775550-001	1		
6-4	71	P1	. . CONNECTOR, RECEPTACLE	00779	582375-9 5935-950-6901	16776053-004	1		
6-4	72	P2	. . CONNECTOR, RECEPTACLE	00779	582378-9 5935-402-7296	16776053-008	1		
6-4	73		. . CONTACT, ELECTRICAL CONNECTOR	00779	66088-3	16776053-102	15		
6-4	74		. . TERMINAL,QUICK DISCONNECT	00779	60598-5	16767598-011	2		
6-4	75		. . TERMINAL, QUICK DISCONNECT	00779	42332-4	16763355-102	1		
6-4	76		. . TERINAL, QUICK DISCONNECT	00779	42599-4	16763355-101	6		
6-4			. CABLE ASSEMBLY, POWER, ELECTRICAL	28009		16785094-001	1		
6-4	77	J1	. . CONNECTOR, RECEPTACLE, ELECTRICAL	00779	1-480304-9	16776774-001	1		
6-4	78		. . CONTACT, ELECTRICAL CONNECTOR	00779	60619-1 5935-104-8550	16776776-007	3		
6-4	79		. SPACER PLATE, MOTHER BOARD	28009		16775882-001	1		
6-4	80		. BLOCK, SPACER, MOTHER BOARD	28009		16775887-002	1		
6-4	81		. BLOCK, PLASTIC, CARD HOLD DOWN	28009		16775886-001	1		
6-4	82		. BLOCK, SPACER, MOTHER BOARD	28009		16775887-001	1		
6-4	83		. RETAINER, CAPACITOR	56289	4586-48 5910-433-1841	16755434-004	3		
6-4	84		. RETAINER, CAPACITOR	56289	4586-97A 5910-626-9604	16755434-003	2		
6-4	85		. GUIDE, PRINTED WIRING BOARD	07556	WEL6375 5835-924-4832	16761256-005	7		
6-4	86		. SUPPORT, CARD GUIDE	28009		16775877-002	1		
6-4	87		. GUIDE, CIRCUIT CARD	28009		16775988-001	2		
6-4	88		. GUIDE, CIRCUIT CARD	28009		16775889-003	1		
6-4	89		. GUIDE, CIRCUIT CARD	28009		16775889-001	3		
6-4	90		. NOT USED						
6-4	91		. ROD, CARD GUIDE	28009		16775874-002	6		
6-4	92		. BAR, STIFFENER, DECK	28009		16775879-001	1		
6-4	93		. BRACKET, DOUBLE ANGLE-- CABLE HOLD DOWN	28009		16776219-001	2		
6-4	94		. BRACKET, DOUBLE ANGLE--CABLE HOLD DOWN	28009		16776219-002	2		
6-4	95		. SHEET CORK AND RUBBER, PRESSURE SENSITIVE, 0.031 IN. THK	28009		16501697-002	AR		
6-4	96		. NOT USED						
6-4	97		. GROMMET, RUBBER	28009		16750991-111	AR		
6-4	98		. GROMMET, RUBBER	28009		16750991-110	AR		
6-4	99		. BOARD, MOUNTING FUSE	75915	357003	16750148-103	1		
6-4	100		. GROMMET, CATERPILLAR	96906	MS21266-1N 5325-960-2410	16750480-001	AR		
6-4	101		. GROMMET, PLASTIC	28009		16757006-019	1		
6-4	102		. PLATE, MOUNTING, COMPONENTS	28009		16776721-003	1		

NOTES:

TABLE 6-4. ELECTRONICS CHASSIS ASSEMBLY (SHEET 5 OF 5)

FIGURE NUMBER	INDEX NUMBER	REFERENCE DESIGNATOR	DESCRIPTION 1 2 3 4 5 6 7	MANUFACTURER'S CODE	MANUFACTURER'S PART NUMBER / FEDERAL STOCK NUMBER	HONEYWELL PART NUMBER	QUANTITY PER ASSEMBLY	USABLE ON CODE	NOTES
6-4	103		. BRACKET, ANGLE, CARD GUIDE MOUNTING, OUTSIDE	28009		16775876-002	1		
6-4	104		. SUPPORT, CARD GUIDE MOUNTING	28009		16775901-005	1		
6-4	105		. CHASSIS, DECK	28009		16775927-002	1		

NOTES

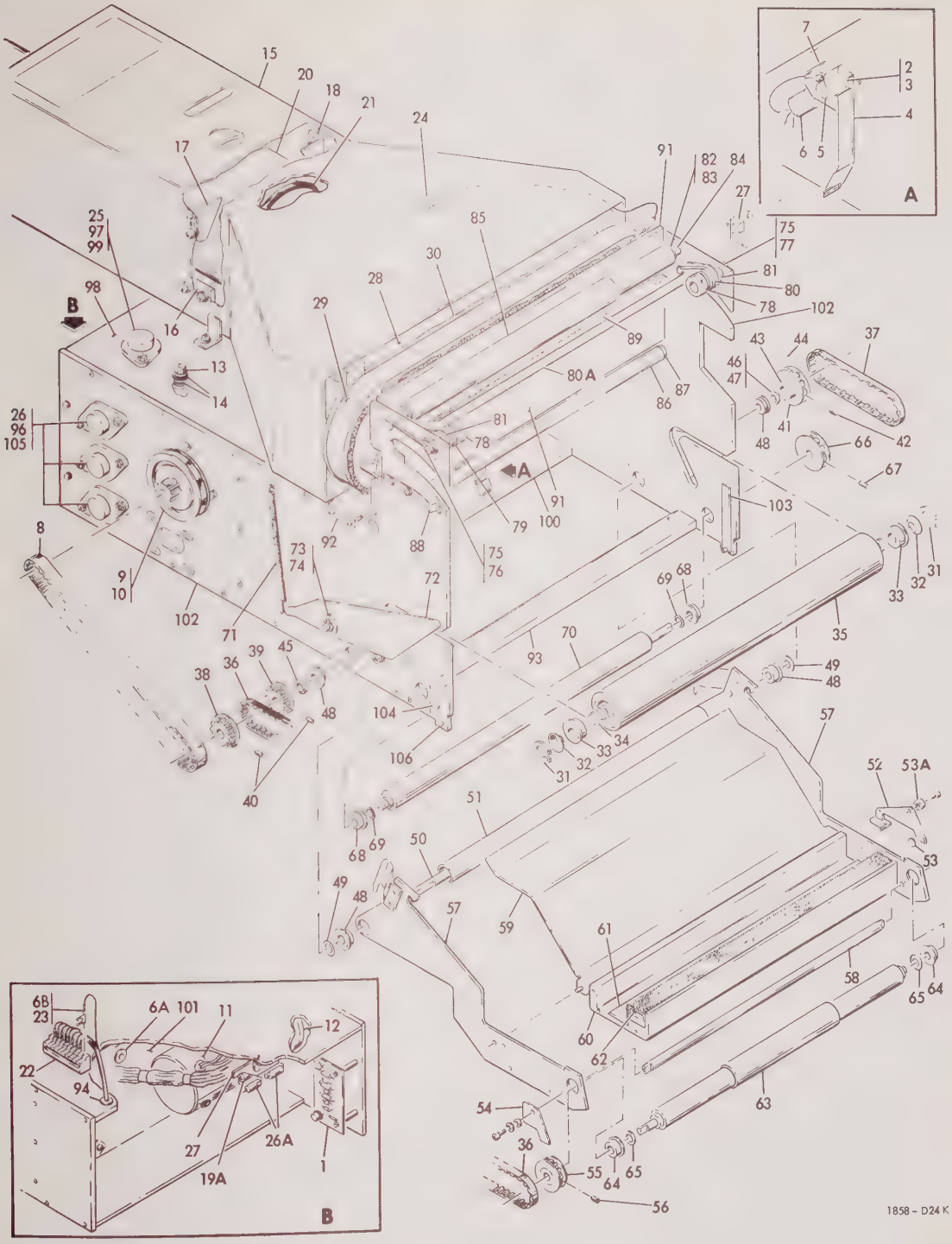

FIGURE 6-5. PAPER DRIVE ASSEMBLY

TABLE 6-5. PAPER DRIVE ASSEMBLY (SHEET 1 OF 4)

FIGURE NUMBER	INDEX NUMBER	REFERENCE DESIGNATOR	DESCRIPTION 1 2 3 4 5 6 7	MANUFACTURER'S CODE	MANUFACTURER'S PART NUMBER / FEDERAL STOCK NUMBER	HONEYWELL PART NUMBER	QUANTITY PER ASSEMBLY	USABLE ON CODE	NOTES
6-5		A4	PAPER DRIVE ASSEMBLY (WITH TAKE-UP) (SEE TABLE 6-1 FOR LOCATION IN NHA)	28009		16779871-007	REF	A	
6-5		A4	PAPER DRIVE ASSEMBLY (WITHOUT TAKE-UP) (SEE TABLE 6-1 FOR LOCATION IN NHA)	28009		16779871-008	REF	B	
6-5	1	A1	. CIRCUIT CARD ASSEMBLY, SERVO CURRENT LIMITER (SEE TABLE 6-17 FOR BREAKDOWN)	28009		16776056-001	1		
76-5		A2	. INDICATOR ASSEMBLY, PAPER SUPPLY	28009		16775979-001	1		
6-5	2		. . HUB, SUPPLY INDICATOR	28009		16775873-002	1		
6-5	3		. . SETSCREW, HEX SOCKET, CUP PT, STL CAD PL, NO. 4-40UNC3A BY 0.187 LG	96906	MS51963-10 5305-717-6949	16750044-010	1		
6-5	4		. . ARM, SENSING, PAPER SUPPLY	28009		16775906-001	1		
6-5	5		. . SPRING, HELICAL	28009		16779066-003	1		
6-5	6		. . RESISTOR, VARIABLE, 20K OHMS, +-20%, 1/2W	01121	WA4N1125203ME	16750055-508	1		
6-5	6A		. . GROMMET, RUBBER	70485	704	16750481-028	1		
6-5	6B		. . CONTACT, ELECTRICAL CONNECTOR	00779	66088-3	16776053-102	2		
6-5	7		. . BRACKE, ANGLE, PAPER SUPPLY INDICATOR	28009		16775878-003	1		
6-5	8		. BELT, POSITIVE DRIVE	71176	130XL025	16755588-022	1		
6-5	9		. SPROCKET WHEEL ASSEMBLY	28009		16779073-001	1		
6-5	10		. SETSCREW, HEX SOCKET, CUP PT, STL BLK OXIDE, NO. 4-40UNC3A BY 0.125 LG	28009	COML	16761013-009	1		
6-5	11	B1/G1	. MOTER/TACHOMETER, DC	28009		16779476-004	1		
6-5	12		. RING, MOTOR MOUNTING	28009		16775894-001	1		
6-5	13	CR1	. SEMICONDUCTOR DEVICE,DIODE	80131	1N1200A 5961-052-5138	16758060-002	1		
6-5	14		. INSULATOR, PLATE	18565	60-11-4659-1664	16783603-003	2		
6-5			. SHIELD ASSEMBLY, ELECTROMAGNETIC CRT	28009		16776013-001	1		
6-5	15		. . SHIELD, ELECTROMAGNETIC, CRT	28009		16788858-001	1		
6-5	16		. . BRACKET, DOUBLE ANGLE, YOKE MOUNTING	28009		16775355-001	1		
6-5	17		. . BRACKET, ANGLE, YOKE MOUNTING, LEFT HAND	28009		16775358-001	1		
6-5	18		. . BRACKET, ANGLE, YOKE MOUNTING, RIGHT HAND	28009		16775358-002	1		
6-5	19	C1	. CAPACITOR, FIXED, CERAMIC DIELECTRIC, 0.22UF, +-20%, 100VDC	72982	8131-100-651-224M	16771020-220	1		
6-5	20	L1A/B	. DEFLECTION YOKE, CRT	99049	C7420	16776084-001	1		
6-5	21		. O-RING	83259	2-021V747-75	16761490-032	1		
6-5	22	P1	. CONNECTOR, RECEPTACLE	00779	582375-9 5935-950-6901	16776053-004	1		

NOTES

TABLE 6-5. PAPER DRIVE ASSEMBLY (SHEET 2 OF 4)

FIGURE NUMBER	INDEX NUMBER	REFERENCE DESIGNATOR	DESCRIPTION 1 2 3 4 5 6 7	MANUFACTURER'S CODE	MANUFACTURER'S PART NUMBER / FEDERAL STOCK NUMBER	HONEYWELL PART NUMBER	QUANTITY PER ASSEMBLY	USABLE ON CODE	NOTES
6-5	23		. CONTACT, ELECTRICAL CONNECTOR	00779	66088-3	16776053-102	3		
6-5	24		. CONNECTOR, ELECTRON TUBE	04435	CD8379	16738937-002	1		
6-5	25	Q1	. TRANSISTOR	80131	2N3766 5961-835-6138	16738403-001	1		
6-5	26	Q2-Q4	. TRANSISTOR	86684	2N6254	16763169-006	3		
6-5	26A	R1,R2	. RESISTOR, FIXED, CARBON COMPOSITION, 270 OHMS, +-5%, 1/2W	81349	RCR20G271JM	16750076-535	2		
6-5	27	S1	. SWITCH	91929	311SM1T	16764580-001	1		
6-5	27A	TB1	. TERMINAL BOARD	71785	332-11-05-092	16750153-026	1		
6-5	28	V1	. ELECTRON TUBE, CATHODE RAY, FIBEROPTIC	01852	10M140PT435MF0	16774509-002	1		
6-5	29		. CLAMP, LOOP	08484	QS100M1165	16771714-023	1		
6-5	30		. SHEET CORK AND RUBBER, PRESSURE SENSITIVE, 0.031 IN. THK	28009		16501697-002	AR		
6-5			. SPINDLE ASSEMBLY, TAKEUP	28009		16778786-001	1	A	
6-5	31		. . RING, RETAINING	79136	5108-50-S-MD	16756271-205	2		
6-5	32		. . WASHER, SPRING TENSION, WAVY, SPRING STEEL, 0.531 IN. ID BY 0.734 IN. OD BY 0.050 IN. THK	70472	W0734-009	16751083-004	2		
6-5	33		. . BEARING,BALL,ANNULAR	21335	5SKDD	16750791-006	2		
6-5	34		. . SHAFT, SHOULDERED	28009		16778787-001	1		
6-5	35		. . ROLLER, TAKEUP	28009		16778788-001	1		
6-5	36		. BELT,POSITIVE DRIVE	71176	160XL013	16200450-001	1		
6-5	37		. BELT, POSITIVE DRIVE	71176	70XL012	16755588-025	1	A	
6-5	38		. SPROCKET WHEEL, POSITIVE DRIVE	28009		16784178-002	1		
6-5	39		. SPROCKET WHEEL, POSITIVE DRIVE	28009		16784178-003	1		
6-5	40		. SETSCREW, HEX SOCKET, CUP PT, STL BLK OXIDE, NO. 4-40UNC3A BY 0.188 LG	28009	COML	16761013-010	2		
6-5	41		. SPROCKET WHEEL, POSITIVE DRIVE	28009		16784178-001	1	A	
6-5	42		. SETSCREW, HEX SOCKET, CUP PT, STL BLK OXIDE, NO. 4-40UNC3A BY 0.188 LG	28009	COML	16761013-010	1	A	
6-5	43		. COLLAR, SHAFT	28009		16764634-002	1	B	
6-5	44		. SETSCREW, HEX SOCKET, CUP PT, STL BLK OXIDE, NO. 8-32UNC3A BY 0.188 LG	28009	COML	16761013-034	1	B	
6-5	45		. SPACER, SLEEVE, ROUND, PRECISION	00328	G70-10	16758128-100	1		
6-5	46		. SPACER, SLEEVE, ROUND, PRECISION	00328	G70-10	16758128-100	1	A	
6-5	47		. SPACER, SLEEVE, ROUND, PRECISION	00328	G70-8	16758128-098	1	B	
6-5	48		. BEARING, BALL, ANNULAR, FLANGED	23589	R1F814ZZ	16738273-134	4		
6-5	49		. SPACER, SLEEVE, ROUND, PRECISION	00328	G70-1 5365-411-4449	16758128-091	AR		
6-5	49		. SPACER, SLEEVE, ROUND, PRECISION	00328	G70-4	16758128-094	AR		
6-5	49		. SPACER, SLEEVE, ROUND, PRECISION	00328	G70-8	16758128-098	AR		
6-5	50		. SHAFT, SHOULDERED, DRIVE	28009		16775316-002	1		

NOTES

TABLE 6-5. PAPER DRIVE ASSEMBLY (SHEET 3 OF 4)

FIGURE NUMBER	INDEX NUMBER	REFERENCE DESIGNATOR	DESCRIPTION 1 2 3 4 5 6 7	MANUFACTURER'S CODE	MANUFACTURER'S PART NUMBER / FEDERAL STOCK NUMBER	HONEYWELL PART NUMBER	QUANTITY PER ASSEMBLY	USABLE ON CODE	NOTES
6-5	51		. TUBE, PIVOT SHAFT	28009		16775310-001	1		
6-5			. PAPER CRADLE ASSEMBLY	28009		16778772-004	1		
6-5	52		. . LEVER ARM, CRADLE LATCH	28009		16775920-001	1		
6-5	53		. . SPACER, SLEEVE, ROUND, PRECISION	00328	G70-1 5365-411-4449	16758128-091	AR		
6-5	53A		. . CONNECTOR, ELECTRON TUBE	04435	CD8379	16781748-001	1		
6-5	54		. . PLATE, CAM, CRADLE LATCH	28009		16775924-001	1		
6-5	55		. . SPROCKET WHEEL, POSITIVE DRIVE	28009		16784178-003	1		
6-5	56		. . SETSCREW, HEX SOCKET, CUP PT, STL BLK OXIDE, NO. 4-40UNC3A BY 0.188 LG	28009	COML	16761013-010	1		
6-5	57		. . SIDE PLATE ASSEMBLY (MATCH PAIR)	28009		16778776-004	1		
6-5	58		. . SHAFT, LEVER ARM, CRADLE LATCH	28009		16775923-001	1		
6-5	59		. . SHIELD, LIGHT	28009		16775306-001	1		
6-5	60		. . SUPPORT, CRADLE	28009		16775302-001	1		
6-5	61		. . BRACKET, ANGLE, PRESSURE PAD MOUNTING	28009		16775303-001	1		
6-5	62		. . PRESSURE PAD ASSEMBLY	28009		16776004-001	1		
6-5	63		. . DRIVE ROLLER	28009		16775315-003	1		
6-5	64		. . BEARING, BALL, ANNULAR, FLANGED	23589	R1F814ZZ	16738273-134	2		
6-5	65		. . SPACER, SLEEVE, ROUND, PRECISION	00328	G70-1 5365-411-4449	16758128-091	AR		
6-5	65		. . SPACER, SLEEVE, ROUND, PRECISION	00328	G70-4	16758128-094	AR		
6-5	65		. . SPACER,SLEEVE, ROUND, PRECISION,	00325	G70-6	16758128-096	AR		
6-5	66		. SPROCKET WHEEL, POSITIVE DRIVE	28009		16784178-003	1	A	
6-5	67		. SETSCREW, HEX SOCKET, CUP PT, STL BLK OXIDE, NO. 4-40UNC3A BY 0.188 LG	28009	COML	16761013-010	1	A	
6-5	68		. BEARING, BALL, ANNULAR, FLANGED	23589	R1F814ZZ	16738273-134	2	A	
6-5	69		. SPACER, SLEEVE, ROUND, PRECISION	00328	G70-1 5365-411-4449	16758128-091	AR	A	
6-5	69		. SPACER, SLEEVE, ROUND, PRECISION	00328	G70-4	16758128-094	AR	A	
6-5	69		. SPACER, SLEEVE, ROUND, PRECISION	00328	G70-7	16758128-097	AR	A	
6-5	70		. DRIVE ROLLER, TAKE-UP	28009		16775314-003	1	A	
6-5	71		. SPRING, HELICAL	84830	LE037C9MW	16738290-013	2	A	
6-5	72		. PRESSURE ARM, TAKEUP SPINDLE	28009		16778771-001	2	A	
6-5	73		. WASHER, NYLON, 0.192 IN. ID BY 0.343 IN. OD BY 0.020 IN. THK	86928	5610-97-20	16737979-020	4	A	
6-5	74		. RING,RETAINING	79136	5555-185	16759863-007	2	A	
6-5	75		. SPACER, SLEEVE, PRESSURE ROLLER	28009		16776248-001	2		
6-5	76		. SPRING, PRESSURE ROLLER, LEFT HAND	28009		16776218-002	1		
6-5	77		. SPRING, PRESSURE ROLLER, RIGHT HAND	28009		16776218-001	1		
6-5	78		. RETAINER, SPRING	28009		16778785-001	2		

NOTES

TABLE 6-5. PAPER DRIVE ASSEMBLY (SHEET 4 OF 4)

FIGURE NUMBER	INDEX NUMBER	REFERENCE DESIGNATOR	DESCRIPTION 1 2 3 4 5 6 7	MANUFACTURER'S CODE	MANUFACTURER'S PART NUMBER / FEDERAL STOCK NUMBER	HONEYWELL PART NUMBER	QUANTITY PER ASSEMBLY	USABLE ON CODE	NOTES
6-5	79		. SPRING, LATCH, LEFT	28009		16775298-002	1		
6-5	80		. SPRING, LATCH, RIGHT	28009		16775298-001	1		
6-5	80A		. ROD, LATCH	28009		16775318-001	1		
6-5	81		. ARM, LATCH	28009		16778872-002	2		
6-5			. PRESSURE ROLLER ASSEMBLY	28009		16776011-001	1		
6-5	82		. . RING, RETAINING	79136	5100-15C 5365-263-5877	16761209-003	2		
6-5	83		. . BEARING, BALL, ANNULAR, FLANGED	83086	SFR166PP 3110-773-9554	16738273-112	2		
6-5	84		. . SHAFT, SHOULDERED, PINCH ROLLER	28009		16775320-001	1		
6-5	85		. . ROLLER, PRESSURE	28009		16775327-001	1		
6-5	86		. ROD, PAPER TURN-AROUND	28009		16775317-001	1		
6-5	87		. BEARING, BALL, ANNULAR, FLANGED	83086	SFR166PP 3110-773-9554	16738273-112	2		
6-5	88		. SPRING, FLAT, DOOR LATCH	28009		16775880-001	2		
6-5	89		. FELT STRIP	28009		16738904-001	AR		
6-5	90		. PLATE, BUTT, CRT, TOP	28009		16775332-001	1		
6-5	91		. PLATE, BUTT, CRT, BOTTOM	28009		16775331-001	1		
6-5	92		. SHIELD, LIGHT, STATIONARY	28009		16775980-001	1		
6-5	93		. BAR, TIE DOWN, PAPER DRIVE	28009		16775895-001	1		
6-5	94		. GROMMET, RUBBER	70485	560	16750481-029	1		
6-5	95		. NOT USED						
6-5	96		. INSULATOR, PLATE	13103	56-03-2AP	16784833-001	3		
6-5	97		. INSULATOR, PLATE	13103	56-66-2AP	16784833-002	1		
6-5	98		. PLATE, TOP	28009		16775305-003	1		
6-5	99		. INSULATOR, TRANSISTOR MOUNTING	91833	4617	16776748-002	1		
6-5	100		. PLATE, BOTTOM	28009		16775308-001	1		
6-5	101		. PLATE ,SUPPORT, REAR	28009		16775885-001	1		
6-5			. SIDE PLATE SUBASSEMBLY WITH TAKE-UP (MATCHED SET)	28009		16778696-001	1		
6-5	102		. . SIDE PLATE, PAPER DRIVE ASSEMBLY, WITH TAKE-UP SLOT (MATCHED SET)	28009		16778695-001	1		
6-5	103		. . SPRING, FLAT, DOOR HINGE	28009		16775967-001	2		
6-5	104		. . GLIDE, DRAWER	26365	979-555	16750460-002	2		
6-5		XQ1	. . NOT USED						
6-5	105	XQ2-XQ4	. . SOCKET, SEMICONDUCTOR	04713	MK15	16765309-001	3		
6-5	106		. . PIN, DOOR HINGE	28009		16775966-001	2		

NOTES:

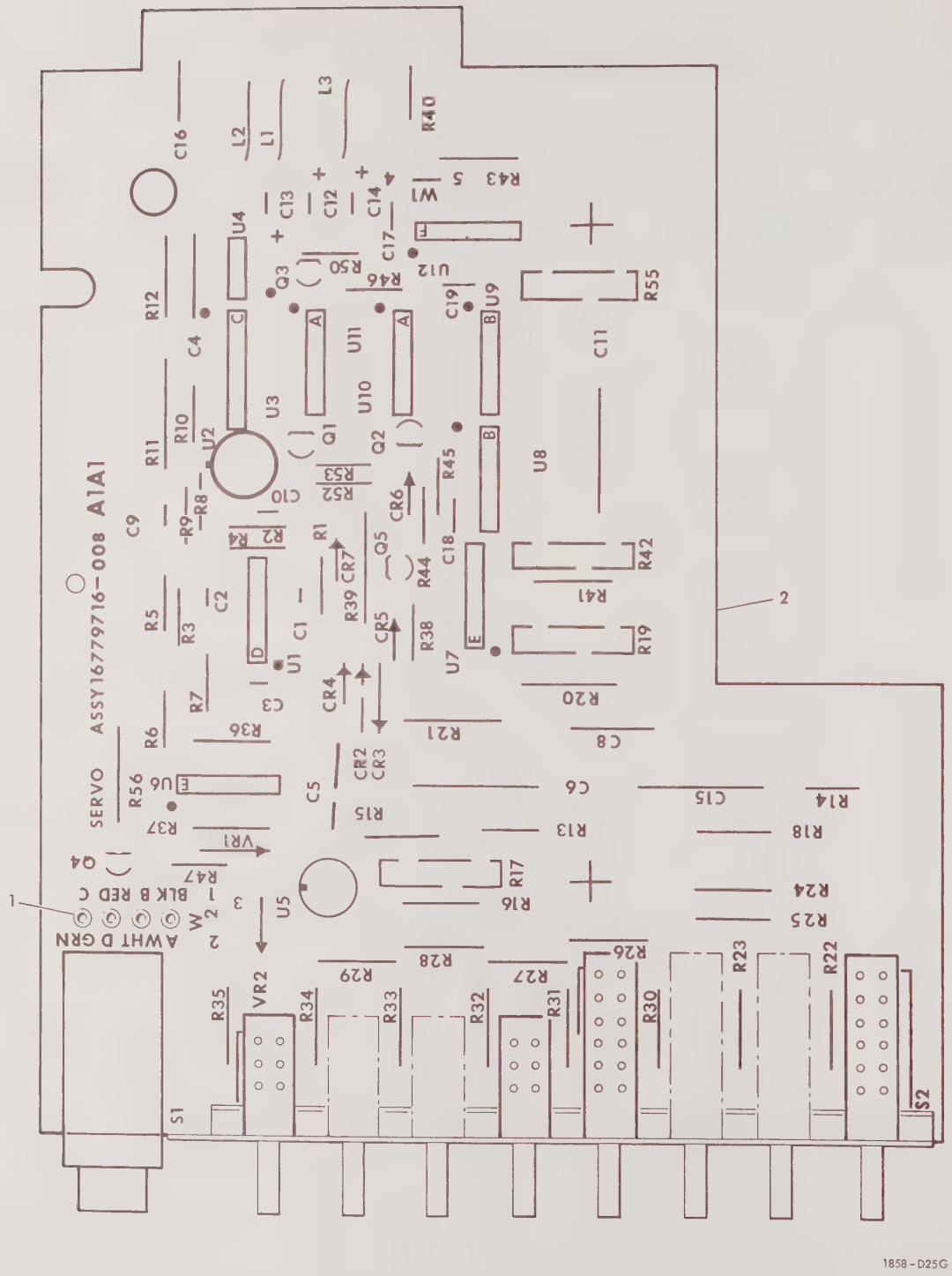

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FIGURE 6-6. SERVO CIRCUIT CARD ASSEMBLY

TABLE 6-6. SERVO CIRCUIT CARD ASSEMBLY (SHEET 1 OF 3)

FIGURE NUMBER	INDEX NUMBER	REFERENCE DESIGNATOR	DESCRIPTION 1 2 3 4 5 6 7	MANUFACTURER'S CODE	MANUFACTURER'S PART NUMBER / FEDERAL STOCK NUMBER	HONEYWELL PART NUMBER	QUANTITY PER ASSEMBLY	USABLE ON CODE	NOTES
6-6		A1A1	CIRCUIT CARD ASSEMBLY, SERVO	28009		16779716-008	REF		
			(SEE TABLE 6-2 FOR LOCATION IN NHA)						
6-6		CR1	. NOT USED				1		
6-6		CR2,CR3	. SEMICONDUCTOR DEVICE,DIODE	28009		16738900-002	2		
6-6		CR4-CR7	. SEMICONDUCTOR DEVICE, DIODE	14433	1N4148	16756865-003	4		
6-6		C1	. CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.022UF, +-10%, 50VDC	18796	8121-050W5R223K	16771625-048	1		
6-6		C2	. CAPACITOR,FIXED,MICA DIELECTRIC, 5PF, +-10%, 500VDC	81349	CM05CD050D03	16761549-003	1		
6-6		C3	. CAPACITOR,FIXED,MICA DIELECTRIC, 10PF, +-10%, 500VDC	81349	CM05CD100K03	16761549-007	1		
6-6		C4	. CAPACITOR, FIXED, PLASTIC, DIELECTRIC, 0.10UF, +-10%, 50VDC	06001	75F1R5A104	16770744-230	1		
6-6		C5	. NOT USED						
6-6		C6	. CAPACITOR, FIXED, PLASTIC, DIELECTRIC, 1UF, +-10%, 50VDC	06001	75F7R5A105	16770744-242	1		
6-6		C7	. NOT USED						
6-6		C8	. CAPACITOR, FIXED, PLASTIC DIELECTRIC, 0.22UF, +-10%, 50VDC	06001	75F4R5A224	16770744-234	1		
6-6		C9,C10	. CAPACITOR,FIXED,CERAMIC DIELECTRIC, 0.01UF, +-20%, 50VDC	56289	C023B500E103M	16757455-002	2		
6-6		C11	. CAPACITOR, FIXED, PLASTIC, DIELECTRIC, 1UF, +-10%, 50VDC	06001	75F7R5A105	16770744-242	1		
6-6		C12,C13	. CAPACITOR, FIXED, ELECTROLYTIC, 100UF, +-10%, 15VDC	26769	KNS107E015K	16758058-246	2		
6-6		C14	. CAPACITOR, FIXED, ELECTROLYTIC, 180UF, +-10%, 6VDC	26769	KNS187E006K	16758058-049	1		
6-6		C15,C16	. NOT USED						
6-6		C17-C19	. CAPACITOR,FIXED,MICA DIELECTRIC, 100PF, +-5%, 500VDC	81349	CM06FD102J03 5910-410-9329	16761549-054	3		
6-6		L1-L3	. COIL,RADIO FREQUENCY	02114	VK200-10-3B 5950-832-4881	16773775-003	3		
6-6		Q1-Q4	. TRANSISTOR	80131	2N3904 5961-892-8706	16762172-002	4		
6-6		Q5	. TRANSISTOR	80131	2N3906 5961-931-0472	16762173-002	1		
6-6		R1	. RESISTOR, FIXED, CARBON COMPOSITION, 2K OHMS, +-5%, 1/4W	81349	RCR07G202JM	16750079-040	1		
6-6		R2	. RESISTOR, FIXED, CARBON COMPOSITION, 20K OHMS, +-5%, 1/4W	81349	RCR07G203JM	16750079-064	1		
6-6		R3,R4	. RESISTOR, FIXED, CARBON COMPOSITION, 10K OHMS, +-5%, 1/4W	81349	RCR07G103JM	16750079-057	2		
6-6		R5	. RESISTOR, FIXED, CARBON COMPOSITION, 20K OHMS, +-5%, 1/4W	81349	RCR07G203JM	16750079-064	1		
6-6		R6	. RESISTOR, FIXED, CARBON COMPOSITION, 75K OHMS, +-5%, 1/4W	81349	RCR07G753JM	16750079-078	1		
6-6		R7	. RESISTOR, FIXED, CARBON COMPOSITION, 20K OHMS, +-5%, 1/4W	81349	RCR07G203JM	16750079-064	1		
6-6		R8	. RESISTOR, FIXED, CARBON COMPOSITION, 390K OHMS, +-5%, 1/4W	81349	RCR07G394JM	16750079-095	1		

NOTES.

TABLE 6-6. SERVO CIRCUIT CARD ASSEMBLY (SHEET 2 OF 3)

FIGURE NUMBER	INDEX NUMBER	REFERENCE DESIGNATOR	DESCRIPTION 1 2 3 4 5 6 7	MANUFACTURER'S CODE	MANUFACTURER'S PART NUMBER / FEDERAL STOCK NUMBER	HONEYWELL PART NUMBER	QUANTITY PER ASSEMBLY	USABLE ON CODE	NOTES
6-6		R9	. RESISTOR, FIXED, CARBON COMPOSITION, 10K OHMS, +-5%, 1/4W	81349	RCR07G103JM	16750079-057	1		
6-6		R10	. RESISTOR, FIXED, CARBON COMPOSITION, 750 OHMS, +-5%, 1/4W	81349	RCR07G751JM	16750079-030	1		
6-6		R11	. RESISTOR, FIXED, CARBON COMPOSITION, 360 OHMS, +-5%, 1W	81349	RCR32G361JM	16750077-552	1		
6-6		R12	. RESISTOR, FIXED, CARBON COMPOSITION, 100 OHMS, +-5%, 1/2W	81349	RCR20G101JM	16750076-525	1		
6-6		R13	. RESISTOR, FIXED, CARBON COMPOSITION, 10K OHMS, +-5%, 1/4W	81349	RCR07G103JM	16750079-057	1		
6-6		R14	. NOT USED						
6-6		R15	. RESISTOR, FIXED, METAL FILM, 7.68K OHMS, +-1%, 1/8W	81349	RNR55K7681FM	16757165-286	1		
6-6		R16	. RESISTOR, FIXED, METAL FILM, 499 OHMS, +-1%, 1/8W	81349	RNR55K4990FM	16757165-168	1		
6-6		R17	. RESISTOR, VARIABLE, 10K OHMS, +-10%, 3/4W	73138	89PR10K	16775165-010	1		
6-6		R18	. RESISTOR, FIXED, METAL FILM, 2K OHMS, +-1%, 1/8W	81349	RNR55K2001FM	16757165-230	1		
6-6		R19	. RESISTOR, VARIABLE, 2K OHMS, +-10%, 3/4W	73138	89PR2K	16775165-008	1		
6-6		R20	. RESISTOR, FIXED, METAL FILM, 4.64K OHMS, +-1%, 1/4W	81349	RNR60K4641FM	16757161-265	1		
6-6		R21	. RESISTOR, FIXED, METAL FILM 2.32K OHMS, +-1%, 1/8W	81349	RNR60K2321FM	16757161-236	1		
6-6		R22	. RESISTOR, FIXED, METAL FILM, 4.53K OHMS, +-1%, 1/8W	81349	RNP55K4531FM	16757165-264	1		
6-6		R23	. RESISTOR, FIXED, METAL FILM, 49.9K OHMS, +-1%, 1/8W	81349	RNR55K4992FM	16757165-368	1		
6-6		R24	. RESISTOR, FIXED, METAL FILM, 4.42K OHMS, +-1%, 1/8W	81349	RNR55K4421FM	16757165-263	1		
6-6		R25	. RESISTOR, FIXED, METAL FILM, 21.5K OHMS, +-1%, 1/8W	81349	RNR55K2152FM	16757165-333	1		
6-6		R26-R29	. RESISTOR, FIXED, METAL FILM, 499 OHMS, +-1%, 1/8W	81349	RNR55K4990FM	16757165-168	4		
6-6		R30-35	. RESISTOR, FIXED, METAL FILM, 1K OHMS, +-1%, 1/8W	81349	RNR55K1001FM	16757165-201	6		
6-6		R36	. RESISTOR, FIXED, METAL FILM 750 OHMS, +-1%, 1/8W	81349	RNR55K7500FM	16757165-185	1		
6-6		R37	. RESISTOR, FIXED, METAL FILM 1.62K OHMS, +-1%, 1/8W	81349	RNR55K1621FM	16757165-221	1		
6-6		R38	. RESISTOR, FIXED, CARBON COMPOSITION, 20K OHMS, +-5%, 1/4W	81349	RCR07G203JM	16750079-064	1		
6-6		R39	. RESISTOR, FIXED, CARBON COMPOSITION, 1.5K OHMS, +-5%, 1W	81349	RCR32G152JM	16750077-567	1		
6-6		R40	. RESISTOR, FIXED, CARBON COMPOSITION, 10 OHMS, +-5%, 1/4W	81349	RCR07G100JM	16750079-143	1		
6-6		R41	. RESISTOR, FIXED, METAL FILM, 80.6K OHMS, +-1%, 1/8W	81349	RNR55K8062FM	16757165-388	1		
6-6		R42	. RESISTOR, VARIABLE, 100K OHMS, +-10%, 3/4W	73138	89PR100K	16775165-014	1		
6-6		R43	. RESISTOR, FIXED, METAL FILM, 4.99K OHMS, +-1%, 1/8W	81349	RNR55K4991FM	16757165-268	1		

NOTES

TABLE 6-6. SERVO CIRCUIT CARD ASSEMBLY (SHEET 3 OF 3)

FIGURE NUMBER	INDEX NUMBER	REFERENCE DESIGNATOR	DESCRIPTION (1 2 3 4 5 6 7)	MANUFACTURER'S CODE	MANUFACTURER'S PART NUMBER / FEDERAL STOCK NUMBER	HONEYWELL PART NUMBER	QUANTITY PER ASSEMBLY	USABLE ON CODE	NOTES
6-6		R44	. RESISTOR, FIXED, CARBON COMPOSITION, 20K OHMS, +-5%, 1/4W	81349	RCR07G203JM	16750079-064	1		
6-6		R45-R47	. RESISTOR, FIXED, CARBON COMPOSITION, 3.3K OHMS, +-5%, 1/4W	81349	RCR07G332JM	16750079-045	3		
6-6		R48,R49	. NOT USED						
6-6		R50	. RESISTOR, FIXED, CARBON COMPOSITION, 4.7K OHMS, +-5%, 1/4W	81349	RCR07G472JM	16750079-049	1		
6-6		R51	. NOT USED						
6-6		R52	. RESISTOR, FIXED, CARBON COMPOSITION, 4.7K OHMS, +-5%, 1/4W	81349	RCR07G472JM	16750079-049	1		
6-6		R53	. RESISTOR, FIXED, CARBON COMPOSITION, 820 OHMS, +-5%, 1/4W	81349	RCR07G821JM	16750079-031	1		
6-6		R54	. NOT USED						
6-6		R55	. RESISTOR, VARIABLE, 100 OHMS, +-20%, 3/4W	73138	89PR100	16775165-004	1		
6-6		R56	. RESISTOR, FIXED, METAL FILM, 33.2K OHMS, +-1%, 1/4W	81349	RNR60K3322FM	16757161-351	1		
6-6		S1	. SWITCH, PUSH, ILLUMINATED	81840	J15101-151	16775411-002	1		
6-6		S2	. SWITCH ASSEMBLY	28009		16775335-013	1		
6-6		U1	. INTEGRATED CIRCUIT,OPERATIONAL AMPLIFIER	18324	L709-1	16763333-103	1		
6-6		U2	. INTEGRATED CIRCUIT, DIFFERENTIAL COMPARATOR	27014	LM311H	16765537-022	1		
6-6		U3	. INTEGRATED CIRCUIT, FLIP FLOP	01295	SN7476N 5962-106-4285	16766919-003	1		
6-6		U4	. INTEGRATED CIRCUIT, BUFFER	01295	SN75451P 5962-497-1587	16775733-001	1		
6-6		U5	. INTEGRATED CIRCUIT, OPERATIONAL AMPLIFIER	04713	MC1456G	16776247-001	1		
6-6		U6,U7	. INTEGRATED CIRCUIT, OPERATIONAL AMPLIFIER (L741-1)	28009		04040505-001	2		
6-6		U8,U9	. INTEGRATED CIRCUIT,COUNTER,HIGH SPEED	01295	SN7493N 5962-684-8336	99000019-001	2		
6-6		U10,U11	. INTEGRATED CIRCUIT,LOGIC GATE	01295	SN7400N 5962-865-4625	99000000-001	2		
6-6		U12	. INTEGRATED CIRCUIT,LOGIC GATE	01295	SN7410N 5962-865-4626	99000010-001	1		
6-6		VR1	. SEMICONDUCTOR DEVICE, DIODE, ZENER	80131	1N821 5961-804-7548	16757931-001	1		
6-6		VR2	. SEMICONDUCTOR DEVICE, DIODE	04713	1N5234B	16774066-114	1		
6-6		W1	. NOT USED						
6-6		W2	. WIRE JUMPER, PREFORMED	28009		16800023-010	1		
6-6	1		. TERMINAL, QUICK DISCONNECT	00779	60809-2	16767598-006	4		
6-6	2		. PRINTED WIRING BOARD	28009		16779715-004	1		

NOTES.

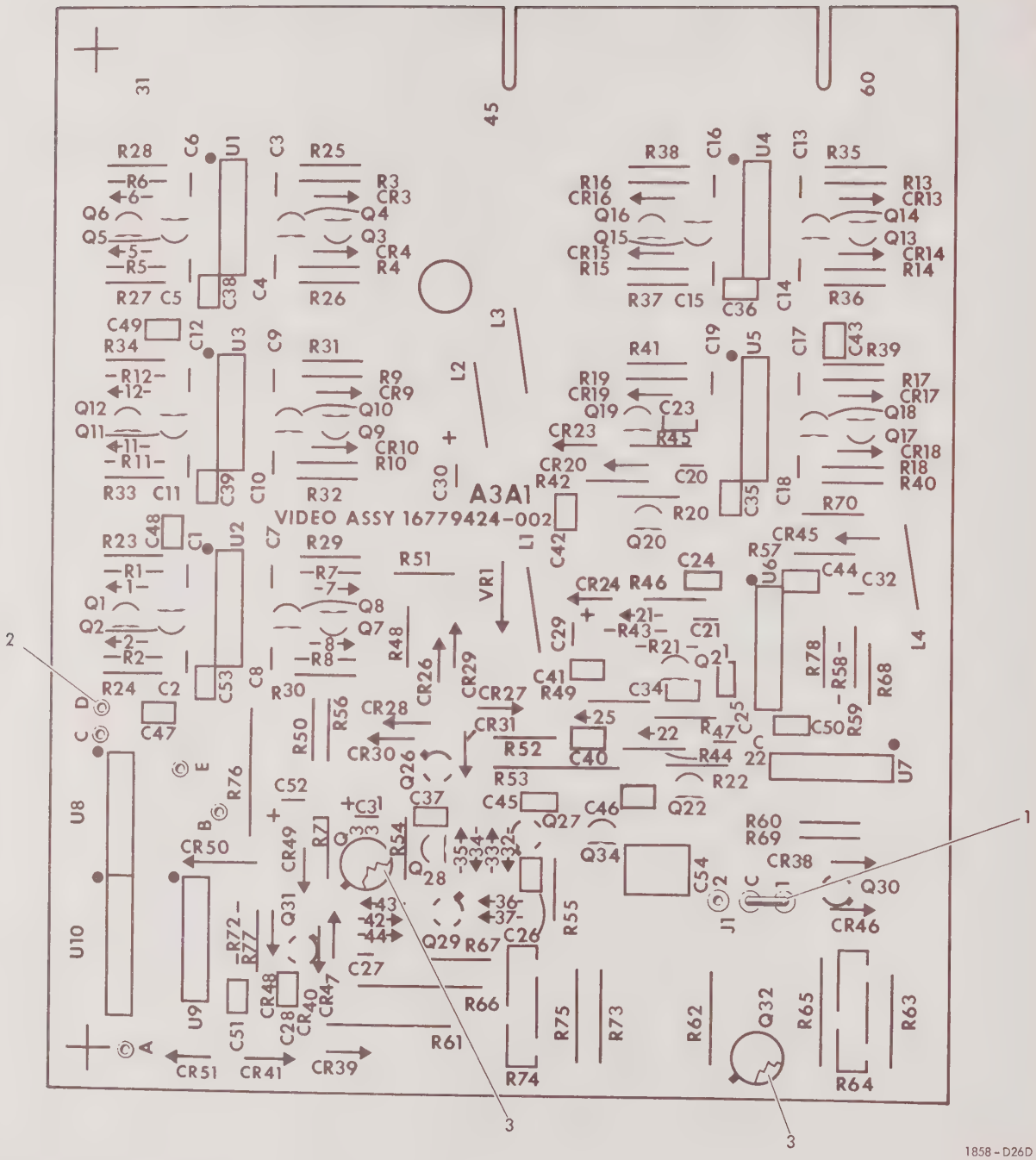


FIGURE 6-7. VIDEO CIRCUIT CARD ASSEMBLY

TABLE 6-7. VIDEO CIRCUIT CARD ASSEMBLY (SHEET 1 OF 4)

FIGURE NUMBER	INDEX NUMBER	REFERENCE DESIGNATOR	DESCRIPTION 1 2 3 4 5 6 7	MANUFACTURER'S CODE	MANUFACTURER'S PART NUMBER / FEDERAL STOCK NUMBER	HONEYWELL PART NUMBER	QUANTITY PER ASSEMBLY	USABLE ON CODE	NOTES
6-7		A3A1	CIRCUIT CARD ASSEMBLY, VIDEO (SEE TABLE 6-4 FOR LOCATION IN NHA)	28009		16779424-002	REF		
6-7		CR1-CR21	. SEMICONDUCTOR DEVICE, DIODE	14433	1N4148	16756865-003	21		
6-7		CR22	. SEMICONDUCTOR DEVICE, DIODE	28480	5082-2800 5961-00-492-7113	16775735-001	1		
6-7		CR23-30	. SEMICONDUCTOR DEVICE, DIODE	14433	1N4148	16756865-003	8		
6-7		CR31	. SEMICONDUCTOR DEVICE, DIODE	28480	5082-2900 5961-110-7491	16775735-101	1		
6-7		CR32-36	. SEMICONDUCTOR DEVICE, DIODE	14433	1N4148	16756865-003	5		
6-7		CR37	. SEMICONDUCTOR DEVICE, DIODE	28480	5082-2800 5961-00-492-7113	16775735-001	1		
6-7		CR38,39	. SEMICONDUCTOR DEVICE, DIODE	14433	1N4148	16756865-003	2		
6-7		CR40	. SEMICONDUCTOR DEVICE, DIODE	28480	5082-2900 5961-110-7491	16775735-101	1		
6-7		CR41	. SEMICONDUCTOR DEVICE, DIODE	14433	1N4148	16756865-003	1		
6-7		CR42	. SEMICONDUCTOR DEVICE, DIODE	28480	5082-2800 5961-00-492-7113	16775735-001	1		
6-7		CR43-49	. SEMICONDUCTOR DEVICE, DIODE	14433	1N4148	16756865-003	7		
6-7		CR50	. SEMICONDUCTOR DEVICE,DIODE	04713	1N4007 5961-018-9785	16756961-007	1		
6-7		CR51	. SEMICONDUCTOR DEVICE, DIODE	14433	1N4148	16756865-003	1		
6-7		C1-C18	. CAPACITOR, FIXED, CERAMIC DIELECTRIC, 120 PF, +-5%, 500 VDC	72982	831-000X5F0121K 5910-465-5562	16761824-021	18		
6-7		C19	. CAPACITOR, FIXED, MICA, DIELECTRIC, 75PF, +-5%, 500VDC	81349	CM05ED750J03	16761549-024	1		1
6-7		C19	. CAPACITOR, FIXED, MICA DIELECTRIC, 82PF, +-5%, 500VDC	81349	CM05ED820J03 5910-00-223-0472	16761549-025	1		1
6-7		C19	. CAPACITOR, FIXED, MICA DIELECTRIC, 91PF, +-5%, 500VDC	81349	CM05FD910J03 5910-456-0810	16761549-026	1		1
6-7		C19	. CAPACITOR,FIXED,MICA DIELECTRIC, 100PF, +-5%, 500VDC	81349	CM05F0101J03 5910-460-0868	16761549-027	1		1
6-7		C19	. CAPACITOR, FIXED, MICA DIELECTRIC 110 PF, +-5%, 500 VDC	81349	CM05ED111J03	16761549-028	1		1
6-7		C19	. CAPACITOR, FIXED,MICA DIELECTRIC, 120 PF, +-5%, 500 VDC	81349	CM05FD121J03 5910-176-7335	16761549-029	1		1
6-7		C20,C21	. CAPACITOR, FIXED, CERAMIC DIELECTRIC, 82PF, +-10%, 500VDC	72982	831-000X5F0-820K	16761824-018	2		
6-7		C22	. CAPACITOR, FIXED, CERAMIC DIELECTRIC, 10PF, +-0.5PF, 500VDC	72982	831-000C0G0-100D 5910-244-6844	16761824-002	1		
6-7		C23,C24	. CAPACITOR, FIXED, CERAMIC DIELECTRIC, 6800PF, +-10%, 50VDC	18796	8121-050W5R682K	16771625-042	2		
6-7		C25	. CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 3300PF, +-10%, 50VDC	18796	8121-050W5R332K	16771625-038	1		
6-7		C26	. CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 390PF, +-10%, 50VDC	18796	8111-050W5R391K	16771625-027	1		
6-7		C27	. CAPACITOR, FIXED, CERAMIC DIELECTRIC, 1UF, +-20%, 50VDC	72982	8131-050-651-105M 5910-498-5856	16771020-025	1		
6-7		C28	. CAPACITOR, FIXED, CERAMIC DIELECTRIC, 0.1 UF, +-20%, 50 VDC	72982	8121-050-651-104M	16771020-018	1		

NOTES:

1. FACTORY SELECTED ITEM

TABLE 6-7. VIDEO CIRCUIT CARD ASSEMBLY (SHEET 2 OF 4)

FIGURE NUMBER	INDEX NUMBER	REFERENCE DESIGNATOR	DESCRIPTION 1 2 3 4 5 6 7	MANUFACTURER'S CODE	MANUFACTURER'S PART NUMBER / FEDERAL STOCK NUMBER	HONEYWELL PART NUMBER	QUANTITY PER ASSEMBLY	USABLE ON CODE	NOTES
6-7		C29	• CAPACITOR, FIXED, ELECTROLYTIC, 180UF, +-10%, 6VDC	28009		16758058-905	1		
6-7		C30,C31	• CAPACITOR, FIXED, ELECTROLYTIC, 100UF, +-10%, 15VDC	28009		16758058-904	2		
6-7		C32	• CAPACITOR, FIXED, CERAMIC DIELECTRIC, 1.0UF, +-20%, 100VDC	72982	8141-100-651-105M 5910-237-2510	16771020-225	1		
6-7		C33	• NOT USED						
6-7		C34-C49	• CAPACITOR, FIXED, CERAMIC DIELECTRIC, 120 PF, +-5%, 500 VDC	72982	831-000X5F0121K 5910-465-5562	16761824-021	15		
6-7		C50	• CAPACITOR, FIXED, CERAMIC DIELECTRIC, 270PF, +-10%, 50VDC	18796	8101-050W5R271K	16771625-025	1		
6-7		C51	• CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 100PF, +-10%, 100VDC	18796	8121-100-C0G-101K	16771625-020	1		
6-7		C52	• CAPACITOR, FIXED, ELECTROLYTIC, 100UF, +-10%, 15VDC	28009		16758058-904	1		
6-7		C53	• CAPACITOR, FIXED, CERAMIC DIELECTRIC, 0.1 UF, +-20%, 50 VDC	72982	8121-050-651-104M	16771020-018	1		
6-7		C54	• CAPACITOR, VARIABLE, CERAMIC DIELECTRIC, 15-60PF, 200VDC	72982	538-006F15-60PF 5910-426-8083	16763335-019	1		
6-7		J1	• JACK, TIP	00779	380598-2	16763228-002	3		
6-7		L1-L4	• COIL,RADIO FREQUENCY	02114	VK200-10-3B 5950-832-4881	16773775-003	4		
6-7	1	P1	• PLUG, TIP	28009		16763229-001	1		
6-7		Q1-Q20	• TRANSISTOR	04713	MPS3640 5961-946-6635	16776367-001	20		
6-7		Q21	• TRANSISTOR	80131	2N3904 5961-892-8706	16762172-001	1		
6-7		Q22	• TRANSISTOR	04713	MPS3640 5961-946-6635	16776367-001	1		
6-7		Q23-Q25	• NOT USED						
6-7		Q26,Q27	• TRANSISTOR	04713	2N2369A	16779202-001	2		
6-7		Q28	• TRANSISTOR	04713	MPS3640 5961-946-6635	16776367-001	1		
6-7		Q29	• TRANSISTOR	80131	2N3737 5961-00-011-7018	99000409-001	1		
6-7		Q30	• TRANSISTOR	04713	2N2369A	16779202-001	1		
6-7		Q31	• TRANSISTOR	80131	2N3904 5961-892-8706	16762172-001	1		
6-7		Q32,Q33	• TRANSISTOR	80131	2N4314 5961-456-4794	16765784-003	2		
6-7		Q34	• TRANSISTOR	04713	MPS3640 5961-946-6635	16776367-001	1		
6-7		R1-R18	• RESISTOR, FIXED, CARBON COMPOSITION, 4.7K OHMS, +-5%, 1/4W	81349	RCR07G472JM	16750079-049	18		
6-7		R19	• RESISTOR, FIXED, CARBON COMPOSITION, 1.2K OHMS, +-5%, 1/4W	81349	RCR07G122JM	16750079-035	1		
6-7		R20,R21	• RESISTOR, FIXED, CARBON COMPOSITION, 68 OHMS, +-5%, 1/4W	81349	RCR07G680JM	16750079-005	2		
6-7		R22	• RESISTOR, FIXED, CARBON COMPOSITION, 100 OHMS, +-5%, 1/4W	81349	RCR07G101JM	16750079-009	1		
6-7		R23-R44	• RESISTOR, FIXED, CARBON COMPOSITION, 470 OHMS, +-5%, 1/4W	81349	RCR07G471JM	16750079-025	22		

NOTES

TABLE 6-7. VIDEO CIRCUIT CARD ASSEMBLY (SHEET 3 OF 4)

FIGURE NUMBER	INDEX NUMBER	REFERENCE DESIGNATOR	DESCRIPTION 1 2 3 4 5 6 7	MANUFACTURER'S CODE	MANUFACTURER'S PART NUMBER / FEDERAL STOCK NUMBER	HONEYWELL PART NUMBER	QUANTITY PER ASSEMBLY	USABLE ON CODE	NOTES
6-7		R45,R46	. RESISTOR, FIXED, CARBON COMPOSITION, 1K OHMS, +-5%, 1/4W	81349	RCR07GF102JM 5905-00-110-7620	16750079-033	2		
6-7		R47	. RESISTOR, FIXED, CARBON COMPOSITION, 2.4K OHMS, +-5%, 1/4W	81349	RCR07G242JM	16750079-042	1		
6-7		R48-R51	. RESISTOR, FIXED, CARBON COMPOSITION, 10K OHMS, +-5%, 1/4W	81349	RCR07G103JM	16750079-057	4		
6-7		R52	. RESISTOR, FIXED, CARBON COMPOSITION, 1.2K OHMS, +-5%, 1/4W	81349	RCR07G122JM	16750079-035	1		
6-7		R53	. RESISTOR, FIXED, CARBON COMPOSITION, 150 OHMS, +-5%, 1W	81349	RCR32G271JM	16750077-549	1		
6-7		R54	. RESISTOR, FIXED, CARBON COMPOSITION, 1K OHMS, +-5%, 1/4W	81349	RCR07GF102JM 5905-00-110-7620	16750079-033	1		
6-7		R55	. RESISTOR, FIXED, CARBON COMPOSITION, 51 OHMS, +-5%, 1/4W	81349	RCR07G510JM	16750079-002	1		
6-7		R56	. RESISTOR, FIXED, CARBON COMPOSITION, 10K OHMS, +-5%, 1/4W	81349	RCR07G103JM	16750079-057	1		
6-7		R57	. RESISTOR, FIXED, CARBON COMPOSITION, 1K OHMS, +-5%, 1/4W	81349	RCR07GF102JM 5905-00-110-7620	16750079-033	1		
6-7		R58	. RESISTOR, FIXED, CARBON COMPOSITION, 4.7K OHMS, +-5%, 1/4W	81349	RCR07G472JM	16750079-049	1		
6-7		R59	. RESISTOR, FIXED, CARBON COMPOSITION, 1K OHMS, +-5%, 1/4W	81349	RCR07GF102JM 5905-00-110-7620	16750079-033	1		
6-7		R60	. RESISTOR, FIXED, CARBON COMPOSITION, 1.2K OHMS, +-5%, 1/4W	81349	RCR07G122JM	16750079-035	1		
6-7		R61	. RESISTOR, FIXED, CARBON COMPOSITION, 1.3K OHMS, +-5%, 1W	81349	RCR32G132JM	16750077-566	1		
6-7		R62	. RESISTOR, FIXED, CARBON COMPOSITION, 1.3K OHMS, +-5%, 1/2W	81349	RCR20G132JM	16750076-553	1		
6-7		R63	. RESISTOR, FIXED, METAL FILM, 1.02K OHMS, +-1%, 1/8W	81349	RNR55K1021FM	16757165-202	1		
6-7		R64	. RESISTOR,VARIABLE,2K OHMS,+-10%, 3/4W	73138	79PR2K 5905-104-0725	16765947-008	1		
6-7		R65	. RESISTOR, FIXED, METAL FILM 2.32K OHMS, +-1%, 1/8W	81349	RNR60K2321FM	16757161-236	1		
6-7		R66	. RESISTOR, FIXED, CARBON COMPOSITION, 820 OHMS, +-5%, 2W	81349	RCR42G820J5 5905-00-152-8755	16750078-049	1		
6-7		R67	. RESISTOR, FIXED, CARBON COMPOSITION, 20K OHMS, +-5%, 1/4W	81349	RCR07G203JM	16750079-064	1		
6-7		R68,R69	. RESISTOR, FIXED, CARBON COMPOSITION, 1K OHMS, +-5%, 1/4W	81349	RCR07GF102JM 5905-00-110-7620	16750079-033	2		
6-7		R70	. RESISTOR, FIXED, CARBON COMPOSITION, 470 OHMS, +-5%, 1/4W	81349	RCR07G471JM	16750079-025	1		
6-7		R71	. RESISTOR, FIXED, CARBON COMPOSITION, 4.7K OHMS, +-5%, 1/4W	81349	RCR07G472JM	16750079-049	1		
6-7		R72	. RESISTOR, FIXED, METAL FILM, 2K OHMS, +-1%, 1/8W	81349	RNR55K2001FS	16757165-230	1		
6-7		R73	. RESISTOR, FIXED, METAL FILM, 5.36K OHMS, +-1%, 1/8W	81349	RNR55K5361FM	16757165-271	1		
6-7		R74	. RESISTOR,VARIABLE,5K OHMS,+-10%, 3/4W	73138	79PR5K 5905-104-0727	16765947-009	1		
6-7		R75	. RESISTOR, FIXED, METAL FILM, 3.01K OHMS, +-1%, 1/8W	81349	RNR55K3011FS	16757165-247	1		
6-7		R76	. RESISTOR, FIXED, CARBON COMPOSITION, 10K OHMS, +-5%, 1W	81349	RCR32G103JM	16750077-587	1		

NOTES:

TABLE 6-7. VIDEO CIRCUIT CARD ASSEMBLY (SHEET 4 OF 4)

FIGURE NUMBER	INDEX NUMBER	REFERENCE DESIGNATOR	DESCRIPTION 1 2 3 4 5 6 7	MANUFACTURER'S CODE	MANUFACTURER'S PART NUMBER / FEDERAL STOCK NUMBER	HONEYWELL PART NUMBER	QUANTITY PER ASSEMBLY	USABLE ON CODE	NOTES
6-7		R77	. RESISTOR, FIXED, CARBON COMPOSITION, 5.6K OHMS, +-5%, 1/4W	81349	RCR07G562JM	16750079-051	1		
6-7		R78	. RESISTOR, FIXED, CARBON COMPOSITION, 2.4K OHMS, +-5%, 1/4W	81349	RCR07G242JM	16750079-042	1		
6-7		U1-U6	. INTEGRATED CIRCUIT, LOGIC GATE	01295	SN74H01N	16776368-001	6		
6-7		U7	. INTEGRATED CIRCUIT, LOGIC GATE	01295	SN74H05N	16776369-011	1		
6-7		U8	. INTEGRATED CIRCUIT, LOGIC GATE	01295	SN74H04N 5962-139-2849	16776369-001	1		
6-7		U9	. INTEGRATED CIRCUIT, MONOSTABLE MULTIVIBRATOR	01295	SN74121N	16775639-001	1		
6-7		U10	. INTEGRATED CIRCUIT, FLIP FLOP	01295	SN7476N 5962-106-4285	16766919-003	1		
6-7		VR1	. SEMICONDUCTOR DEVICE DIODE,ZENER	04713	1N4735A 5961-904-2020	16737938-108	1		
6-7	2		. TERMINAL, QUICK DISCONNECT	00779	60809-2	16767598-006	5		
6-7	3		. PAD, SEMICONDUCTOR	29866	30032	16750179-001	2		

NOTES

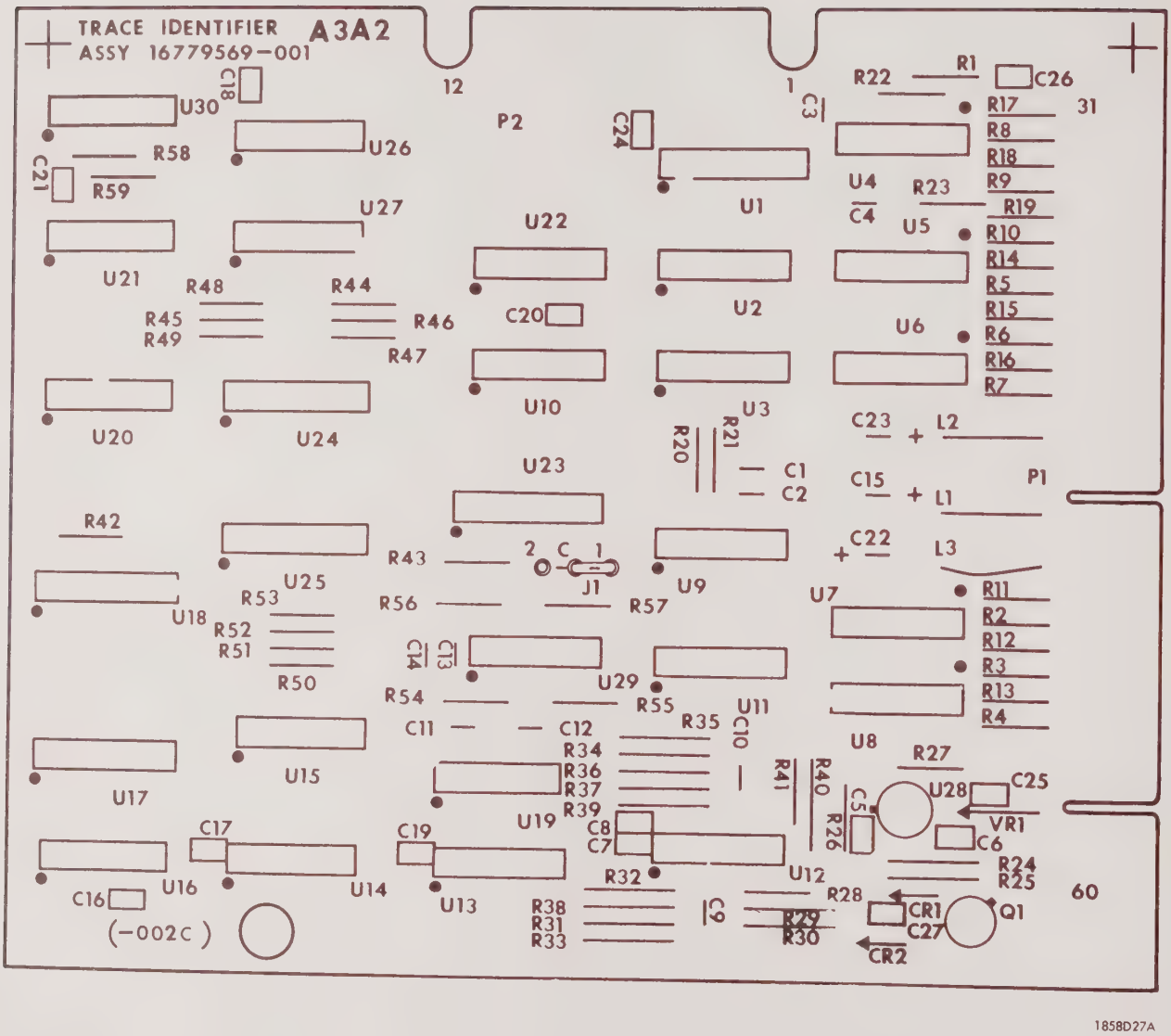


FIGURE 6-8. TRACE IDENTIFIER CIRCUIT CARD ASSEMBLY

TABLE 6-8. TRACE IDENTIFIER CIRCUIT CARD ASSEMBLY (SHEET 1 OF 3)

FIGURE NUMBER	INDEX NUMBER	REFERENCE DESIGNATOR	DESCRIPTION 1 2 3 4 5 6 7	MANUFACTURER'S CODE	MANUFACTURER'S PART NUMBER / FEDERAL STOCK NUMBER	HONEYWELL PART NUMBER	QUANTITY PER ASSEMBLY	USABLE ON CODE	NOTES
6-8		A3A2	CIRCUIT CARD ASSEMBLY, 32-CHANNEL TRACE IDENTIFIER (SEE TABLE 6-4 FOR LOCATION IN NHA)	28009		16779569-001	AR		
6-8		CR1,CR2	. SEMICONDUCTOR DEVICE,DIODE	81349	1N4148 5961-938-1135	16756865-003	2		
6-8		C1-C4	. CAPACITOR, FIXED, CERAMIC DIELECTRIC, 82PF, +-10%, 500VDC	72982	831-000X5F0-820K	16761824-018	4		
6-8		C5-C8	. CAPACITOR, FIXED, CERAMIC DIELECTRIC, 0.1 UF, +-20%, 50 VDC	72982	8121-050-651-104M	16771020-018	4		
6-8		C9-C10	. CAPACITOR, FIXED, CERAMIC DIELECTRIC, 330PF, +-10%, 500VDC	72982	831-000X5F0-331K 5910-883-5967	16761824-029	2		
6-8		C11-C14	. CAPACITOR,FIXED,CERAMIC DIELECTRIC, 75PF,+-10%, 500 VDC	72982	831-000-X5F0-750K	16761824-017	4		
6-8		C15	. CAPACITOR,FIXED,ELECTROLYTIC, 180UF,+-10%,6VDC	17554	TD5-006-187-10	16758058-049	1		
6-8		C16-C21	. CAPACITOR, FIXED, CERAMIC DIELECTRIC, 0.1 UF, +-20%, 50 VDC	72982	8121-050-651-104M	16771020-018	6		
6-8		C22-C23	. CAPACITOR, FIXED, ELECTROLYTIC, 100UF, +-10%, 15VDC	17554	TD5-015-107-10	16758058-246	2		
6-8		C24-C26	. CAPACITOR, FIXED, CERAMIC DIELECTRIC, 0.1 UF, +-20%, 50 VDC	72982	8121-050-651-104M	16771020-018	3		
6-8		C27	. CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 220PF, +-10%, 50VDC	18796	8101-050W5R221K 5910-137-8704	16771625-024	1		
6-8		J1-J2,C	. JACK,TIP	00779	380598-2	16763228-002	3		
6-8		L1-L3	. COIL,RADIO FREQUENCY	02114	VK200-10-3B 5950-832-4881	16773775-003	3		
6-8		P1,P2	. NOT USED						
6-8		P3	. PLUG,TIP	28009		16763229-001	1		
6-8		Q1	. TRANSISTOR	04713	2N2369A	16779202-001	1		
6-8		R1-R19	. RESISTOR,FIXED,CARBON COMPOSITION 6.2KOHMS,+-5%,1/4W	81349	RC07GF622J 5905-682-4100	16750079-052	19		
6-8		R20-R23	. RESISTOR, FIXED, CARBON COMPOSITION, 620 OHMS, +-5%, 1/4W	81349	RC07GF621J 5905-801-6998	16750079-028	4		
6-8		R24	. RESISTOR,FIXED,FILM,3.4K OHMS, +-1%,1/8W	81349	RN55C3401F 5905-997-5234	16757165-252	1		
6-8		R25	. RESISTOR, FIXED, METAL FILM 12.1K OHMS, +-1%, 1/8W	81349	RN55C1212F 5905-982-0473	16757165-309	1		
6-8		R26	. RESISTOR, FIXED, CARBON COMPOSITION, 56 K OHMS, +-5%, 1/4 W	81349	RC07GF563J 5905-800-0179	16750079-075	1		
6-8		R27	. RESISTOR,FIXED,CARBON COMPOSITION 3.9K OHMS,+-5%,1/4W	81349	RC07GF392J 5905-682-4098	16750079-047	1		
6-8		R28	. RESISTOR,FIXED,CARBON COMPOSITION 2K OHMS,+-5%,1/4W	81349	RC07GF202J 5905-686-3370	16750079-040	1		
6-8		R29	. RESISTOR, FIXED, METAL FILM, 1K OHMS, +-1%, 1/8W	81349	RN55C1001F 5905-982-0477	16757165-201	1		
6-8		R30	. RESISTOR, FIXED, METAL FILM, 2.94 K OHMS, +-1%, 1/8 W	81349	RN55C2941F 5905-972-3482	16757165-246	1		
6-8		R31	. RESISTOR, FIXED, METAL FILM, 15K OHMS,+-1%,1/8W	81349	RN55C1502F 5905-982-0214	16757165-318	1		
6-8		R32	. RESISTOR,FIXED,FILM,1.5K OHMS, +-1%,1/8W	81349	RN55C1501F 5905-982-0197	16757165-218	1		

NOTES:

TABLE 6-8. TRACE IDENTIFIER CIRCUIT CARD ASSEMBLY (SHEET 2 OF 3)

FIGURE NUMBER	INDEX NUMBER	REFERENCE DESIGNATOR	DESCRIPTION 1 2 3 4 5 6 7	MANUFACTURER'S CODE	MANUFACTURER'S PART NUMBER / FEDERAL STOCK NUMBER	HONEYWELL PART NUMBER	QUANTITY PER ASSEMBLY	USABLE ON CODE	NOTES
6-8		R33,R34	• RESISTOR,FIXED,FILM,2K OHMS,+-1%, 1/8W	81349	RN55C2001F 5905-985-5798	16757165-230	2		
6-8		R35	• RESISTOR, FIXED, METAL FILM, 2.94 K OHMS, +-1%, 1/8 W	81349	RN55C2941F 5905-972-3492	16757165-246	1		
6-8		R36	• RESISTOR, FIXED, METAL FILM, 15K OHMS,+-1%,1/8W	81349	RN55C1502F 5905-982-0214	16757165-318	1		
6-8		R37,R38	• RESISTOR, FIXED, METAL FILM, 1K OHMS, +-1%, 1/8W	81349	RN55C1001F 5905-982-0477	16757165-201	2		
6-8		R39	• RESISTOR, FIXED, METAL FILM, 806 OHMS, +-1%, 1/8W	81349	RN55C8060F 5905-900-0021	16757165-188	1		
6-8		R40	• RESISTOR, FIXED, METAL FILM, 1K OHMS, +-1%, 1/8W	81349	RN55C1001F 5905-982-0477	16757165-201	1		
6-8		R41	• RESISTOR,FIXED,CARBON COMPOSITION 2K OHMS,+-5%,1/4W	81349	RC07GF202J 5905-686-3370	16750079-040	1		
6-8		R42	• RESISTOR,FIXED,CARBON COMPOSITION 1K OHMS, +-5%, 1/4W	81349	RC07GF102J 5905-681-6462	16750079-033	1		
6-8		R43-R49	• RESISTOR,FIXED,CARBON COMPOSITION 2K OHMS,+-5%,1/4W	81349	RC07GF202J 5905-686-3370	16750079-040	7		
6-8		R50-R57	• RESISTOR,FIXED,CARBON COMPOSITION 470 OHMS,+-5%,1/4W	81349	RC07GF471J 5905-583-2242	16750079-025	8		
6-8		R58,R59	• RESISTOR,FIXED,CARBON COMPOSITION 4.7K OHMS,+-5%,1/4W	81349	RC07GF472J 5905-686-9998	16750079-049	2		
6-8		U1	• INTEGRATED CIRCUIT, DECODER	01295	SN7442N-00	16775732-001	1		
6-8		U2,U3	• INTEGRATED CIRCUIT,HEX INVERTER	01295	SN7404N 5962-404-2259	99000004-001	2		
6-8		U4-U8	• INTEGRATED CIRCUIT, LOGIC GATE	01295	SN74H01N	16776368-001	5		
6-8		U9	• INTEGRATED CIRCUIT,LOGIC GATE	01295	SN7410N 5962-865-4626	99000010-001	1		
6-8		U10	• INTEGRATED CIRCUIT, LOGIC GATE	28009		99000184-001	1		
6-8		U11	• INTEGRATED CIRCUIT, BUFFER	01295	SN74540N	16776698-002	1		
6-8		U12	• INTEGRATED CIRCUIT, VOLTAGE COMPARATOR, DUAL	18324	NE 521A	16779478-001	1		
6-8		U13	• INTEGRATED CIRCUIT, LOGIC GATE	01295	SN74H01N	16776368-001	1		
6-8		U14	• INTEGRATED CIRCUIT, LOGIC GATE	01295	SN7408N	99000008-001	1		
6-8		U15	• INTEGRATED CIRCUIT,HEX INVERTER	01295	SN7404N 5962-404-2259	99000004-001	1		
6-8		U16	• INTEGRATED CIRCUIT,COUNTER,HIGH SPEED	01295	SN7490N 5962-102-7519	99000018-001	1		
6-8		U17	• INTEGRATED CIRCUIT, FLIP FLOP	01295	SN7476N 5962-106-4285	16766919-003	1		
6-8		U18	• INTEGRATED CIRCUIT, SHIFT REGISTER	01295	SN7496N-00	16775376-001	1		
6-8		U19	• INTEGRATED CIRCUIT,LOGIC GATE	01295	SN7410N 5962-865-4626	99000010-001	1		
6-8		U20	• INTEGRATED CIRCUIT, SHIFT REGISTER	01295	SN74164N	16779427-001	1		
6-8		U21	• INTEGRATED CIRCUIT, LOGIC GATE	28009		30731648-001	1		
6-8		U22	• INTEGRATED CIRCUIT,COUNTER,HIGH SPEED	01295	SN7490N 5962-102-7519	99000018-001	1		
6-8		U23	• INTEGRATED CIRCUIT, FLIP FLOP	01295	SN7476N 5962-106-4285	16766919-003	1		

NOTES

TABLE 6-8. TRACE IDENTIFIER CIRCUIT CARD ASSEMBLY (SHEET 3 OF 3)

FIGURE NUMBER	INDEX NUMBER	REFERENCE DESIGNATOR	DESCRIPTION 1 2 3 4 5 6 7	MANUFACTURER'S CODE	MANUFACTURER'S PART NUMBER / FEDERAL STOCK NUMBER	HONEYWELL PART NUMBER	QUANTITY PER ASSEMBLY	USABLE ON CODE	NOTES
6-8		U24,U25	. INTEGRATED CIRCUIT, DECODER/ DRIVER	01295	SN7447AN	16778119-001	2		
6-8		U26	. INTEGRATED CIRCUIT, LOGIC GATE	01295	SN74S00N	16776155-001	1		
6-8		U27	. INTEGRATED CIRCUIT, LOGIC GATE	28009		99000184-001	1		
6-8		U29	. INTEGRATED CIRCUIT, DIFFERENTIAL COMPARATOR	07263	U5B771039X 5962-241-0667	16765537-001	1		
6-8		U23	. INTEGRATED CIRCUIT, LOGIC GATE	01295	SN74S00N	16776155-001	1		
6-8		U30	. INTEGRATED CIRCUIT, LOGIC GATE	01295	SN74H01N	16776368-001	1		
6-8			. PRINTED CIRCUIT CARD, 32-CHANNEL TRACE IDENTIFIER	28009		16779568-002	1		

NOTES

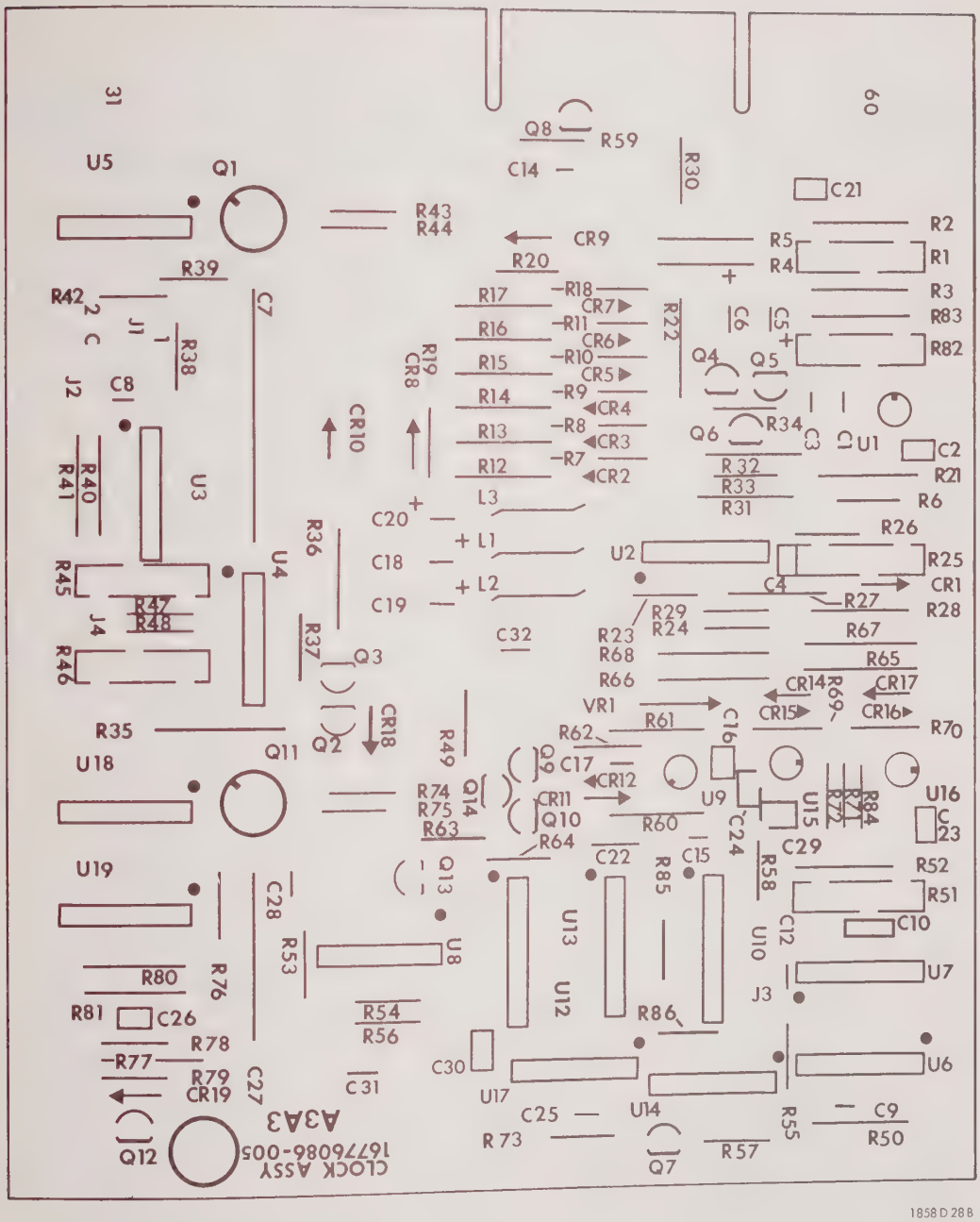


FIGURE 6-9. CLOCK CIRCUIT CARD ASSEMBLY

TABLE 6-9. CLOCK CIRCUIT CARD ASSEMBLY (SHEET 1 OF 6)

FIGURE NUMBER	INDEX NUMBER	REFERENCE DESIGNATOR	DESCRIPTION 1 2 3 4 5 6 7	MANUFACTURER'S CODE	MANUFACTURER'S PART NUMBER / FEDERAL STOCK NUMBER	HONEYWELL PART NUMBER	QUANTITY PER ASSEMBLY	USABLE ON CODE	NOTES
6-9		A3A3	CIRCUIT CARD ASSEMBLY, CLOCK (SEE TABLE 6-4 FOR LOCATION IN NHA)	28009		16776086-005	REF		
6-9		CR1-CR12	. SEMICONDUCTOR DEVICE,DIODE	81349	1N4148 5961-938-1135	16756865-003	12		
6-9		CR13	. NOT USED						
6-9		CR14-19	. SEMICONDUCTOR DEVICE,DIODE	81349	1N4148 5961-938-1135	16756865-003	6		
6-9		C1	. CAPACITOR, FIXED, MICA, DIELECTRIC, 150UUF, +-5%, 500VDC	81349	CM05FD151J03	16761549-031	1		
6-9		C2	. CAPACITOR, FIXED, CERAMIC DIELECTRIC, 0.1 UF, +-20%, 50 VDC	72982	8121-050-651-104M	16771020-018	1		
6-9		C3	. CAPACITOR,FIXED,MICA DIELECTRIC, 6PF, +-10%, 500VDC	81349	CM05CD060D03 5910-044-4138	16761549-004	1		
6-9		C4	. CAPACITOR, FIXED, CERAMIC DIELECTRIC, 0.1 UF, +-20%, 50 VDC	72982	8121-050-651-104M	16771020-018	1		
6-9		C5,C6	. CAPACITOR, FIXED, ELECTROLYTIC, 100 UF, +-10%, 15 VDC	17554	C4110	16758058-904	2		
6-9		C7	. CAPACITOR, FIXED, PLASTIC, DIELECTRIC, 2UF, +-10%, 200VDC	84411	X663F20592W2	16750014-018	1		
6-9		C8	. CAPACITOR, FIXED, MICA, DIELECTRIC, 150UUF, +-5%, 500VDC	81349	CM05FD151J03	16761549-031	1		
6-9		C9	. CAPACITOR, FIXED, CERAMIC DIELECTRIC, 1200 PF, +-5%, 100VDC	18796	8131-100-C0G-122J	16771624-112	1		
6-9		C10	. CAPACITOR, FIXED, CERAMIC DIELECTRIC, 2200 PF, +-10%, 100 VDC	18796	8131-100C0G0222K	16771625-115	1		
6-9		C11	. NOT USED						
6-9		C12	. CAPACITOR,FIXED,CERAMIC DIELECTRIC,0.005UF,+-20%,50VDC	56289	C023B500E502M	16757455-001	1		
6-9		C13	. NOT USED						
6-9		C14	. CAPACITOR,FIXED,MICA DIELECTRIC, 30PF,+-5%,500VDC	81349	CM05ED300J03	16761549-014	1		
6-9		C15	. CAPACITOR, FIXED, MICA, DIELECTRIC, 150UUF, +-5%, 500VDC	81349	CM05FD151J03	16761549-031	1		
6-9		C16	. CAPACITOR, FIXED, CERAMIC DIELECTRIC, 0.1 UF, +-20%, 50 VDC	72982	8121-050-651-104M	16771020-018	1		
6-9		C17	. CAPACITOR, FIXED, MICA, DIELECTRIC, 150UUF, +-5%, 500VDC	81349	CM05FD151J03	16761549-031	1		
6-9		C18	. CAPACITOR, FIXED, ELECTROLYTIC, 180 UF, +-10 %, 6 VDC	17554	C4108	16758058-905	1		
6-9		C19,C20	. CAPACITOR, FIXED, ELECTROLYTIC, 100 UF, +-10%, 15 VDC	17554	C4110	16758058-904	2		
6-9		C21	. CAPACITOR, FIXED, CERAMIC DIELECTRIC, 0.1UF, +-20%, 100VDC	72982	8121-100-651-104M	16771020-218	1		
6-9		C22	. CAPACITOR, FIXED, PLASTIC, DIELECTRIC, 0.047UF, +-10%, 50VDC	06001	75F1R5A473	16770744-226	1		
6-9		C23,C24	. CAPACITOR, FIXED, CERAMIC DIELECTRIC, 0.1 UF, +-20%, 50 VDC	72982	8121-050-651-104M	16771020-018	2		
6-9		C25	. CAPACITOR,FIXED,CERAMIC DIELECTRIC,0.01UF,+-5%,50VDC	18796	8121-050W5R-103J	16771624-044	1		
6-9		C26	. CAPACITOR,FIXED,CERAMIC DIELECTRIC,1000UUF,+-20%,50VDC	72982	8101-050-651-102M	16771020-003	1		

TABLE 6-9. CLOCK CIRCUIT CARD ASSEMBLY (SHEET 2 OF 6)

FIGURE NUMBER	INDEX NUMBER	REFERENCE DESIGNATOR	DESCRIPTION 1 2 3 4 5 6 7	MANUFACTURER'S CODE	MANUFACTURER'S PART NUMBER / FEDERAL STOCK NUMBER	HONEYWELL PART NUMBER	QUANTITY PER ASSEMBLY	USABLE ON CODE	NOTES
6-9		C27	. CAPACITOR, FIXED, PLASTIC DIELECTRIC, 1.0UF, +-10%, 63VDC	28009		16776508-005	1		
6-9		C28	. CAPACITOR,FIXED,CERAMIC DIELECTRIC,0.005UF,+-20%,50VDC	56289	C023B500E502M	16757455-001	1		
6-9		C29	. CAPACITOR, FIXED, CERAMIC DIELECTRIC, 22 PF, +-5%, 100 VDC	18796	8111-100C0G220J	16771624-012	1		
6-9		C30	. CAPACITOR, FIXED, CERAMIC DIELECTRIC, 220PF,+-5%, 50VDC	18796	8101-050W5R221J	16771624-024	1		
6-9		C31,C32	. CAPACITOR,FIXED,CERAMIC DIELECTRIC,0.01UF,+-20%,50VDC	56289	C023B500E103M	16757455-002	2		
6-9		J1	. JACK, TIP	00779	380598-2	16763228-002	3		
6-9		J2-J5	. TERMINAL, QUICK DISCONNECT	00779	60809-2	16767598-006	4		
6-9		L1-L3	. COIL,RADIO FREQUENCY	02114	VK200-10-3B 5950-832-4881	16773775-003	3		
6-9		P1	. PLUG, TIP	28009		16763229-002	1		
6-9		Q1	. TRANSISTOR	27014	2N3958	16774664-107	1		
6-9		Q2	. TRANSISTOR	80131	2N3904 5961-892-8706	16762172-002	1		
6-9		Q3,Q4	. TRANSISTOR	04713	2N3906 5961-072-0128	16762173-002	2		
6-9		Q5-Q7	. TRANSISTOR	80131	2N3904 5961-892-8706	16762172-002	3		
6-9		Q8	. TRANSISTOR	04713	2N2369A	16779202-001	1		
6-9		Q9	. TRANSISTOR	04713	2N3906 5961-072-0128	16762173-002	1		
6-9		Q10	. TRANSISTOR	80131	2N3904 5961-892-8706	16762172-002	1		
6-9		Q11	. TRANSISTOR	27014	2N3958	16774664-107	1		
6-9		Q12	. TRANSISTOR	04713	2N3906 5961-072-0128	16762173-002	1		
6-9		Q13	. TRANSISTOR	04713	MPSA17-5	16776979-001	1		
6-9		Q14	. TRANSISTOR	80131	2N3904 5961-892-8706	16762172-002	1		
6-9		R1	. RESISTOR, VARIABLE, 50 OHMS, +-10%, 3/4W	73138	79PR50	16763947-003	1		
6-9		R2	. RESISTOR, FIXED, METAL FILM, 73.2 OHMS, +-1%, 1/8W	81349	RN55C73R2F 5905-975-1678	16757165-084	1		
6-9		R3	. RESISTOR, FIXED, METAL FILM, 2.37K OHMS, +-1%, 1/8W	81349	RN55C2371F 5905-975-1638	16757165-237	1		
6-9		R4	. RESISTOR, FIXED, METAL FILM, 20K OHMS, +-1%, 1/8W	81349	RN55C2002 5905-982-0927	16757165-330	1		
6-9		R5	. RESISTOR,FIXED,METAL FILM,301 OHMS,+-1%,1/8W	81349	RN55C3010F 5905-959-6635	16757165-147	1		
6-9		R6	. RESISTOR,FIXED,CARBON COMPOSITION 150 OHMS,+-5%,1/4W	81349	RC07GF151J 5905-683-2243	16750079-013	1		
6-9		R7	. RESISTOR, FIXED, METAL FILM, 143K OHMS, +-1%, 1/8W	07716	CCMT0-1433F	16757165-416	1		
6-9		R8	. RESISTOR, FIXED, METAL FILM, 102K OHMS, +-1%, 1/8W	07716	CCMT0-1023F	16757165-402	1		
6-9		R9	. RESISTOR, FIXED, METAL FILM, 88.7K OHMS, +-1%, 1/8W	81349	RN55C8872F 5905-904-4234	16757165-392	1		

NOTES

TABLE 6-9. CLOCK CIRCUIT CARD ASSEMBLY (SHEET 3 OF 6)

FIGURE NUMBER	INDEX NUMBER	REFERENCE DESIGNATOR	DESCRIPTION 1 2 3 4 5 6 7	MANUFACTURER'S CODE	MANUFACTURER'S PART NUMBER / FEDERAL STOCK NUMBER	HONEYWELL PART NUMBER	QUANTITY PER ASSEMBLY	USABLE ON CODE	NOTES
6-9		R10	RESISTOR, FIXED, METAL FILM 11K OHMS, +-1%, 1/8W	81349	RN55C1102F 5905-982-0934	16757165-305	1		
6-9		R11	RESISTOR, FIXED, METAL FILM, 11.5K OHMS, +-1%, 1/8W	81349	RN55C1152F 5905-975-1647	16757165-307	1		
6-9		R12	RESISTOR,FIXED,METALFILM,5.9K OHMS,+-1%,1/8W	81349	RN55C5901F 5905-904-4400	16757165-275	1		
6-9		R13,R14	RESISTOR, FIXED, METAL FILM, 6.04K OHMS, +-1%, 1/8W	81349	RN55C6041F 5905-782-0321	16757165-276	2		
6-9		R15	RESISTOR, FIXED, METAL FILM, 84.5K OHMS, +-1%, 1/8W	81349	RN55C8452F 5905-972-3595	16757165-390	1		
6-9		R16	RESISTOR, FIXED, METAL FILM, 61.9 K OHMS, +-1%, 1/8 W	81349	RN55C6192F 5905-982-0940	16757165-377	1		
6-9		R17	RESISTOR, FIXED, METAL FILM, 52.3K OHMS, +-1%, 1/8W	81349	RN55C5232F 5905-982-0951	16757165-370	1		
6-9		R18	RESISTOR, FIXED, METAL FILM, 11.8K OHMS, +-1%, 1/8 W	81349	RN55C1182F 5905-972-3462	16757165-308	1		
6-9		R19	RESISTOR,FIXED,CARBON COMPOSITION 6.2KOHMS,+-5%,1/4W	81349	RC07GF622J 5905-682-4100	16750079-052	1		
6-9		R20	RESISTOR, FIXED, CARBON COMPOSITION, 3.6K OHMS,+-5%, 1/4W	81349	RC07GF362J 5905-805-9714	16750079-046	1		
6-9		R21,R22	RESISTOR,FIXED,CARBON COMPOSITION 180 OHMS,+-5%,1/2W	81349	RC20GF181J 5905-279-3514	16750076-531	2		
6-9		R23	RESISTOR,FIXED,CARBON COMPOSITION 16K OHMS,+-5%,1/4W	81349	RC07GF163J 5905-752-3186	16750079-062	1		
6-9		R24	RESISTOR,FIXED,CARBON COMPOSITION 27K OHMS,+-5%,1/4W	81349	RC07GF273J 5905-686-3838	16750079-067	1		
6-9		R25	RESISTOR,VARIABLE,50K OHMS,+-10%, 3/4W	73138	79PR50K 5905-122-3806	16763947-013	1		
6-9		R26	RESISTOR, FIXED, CARBON COMPOSITION, 7.5K OHMS, +-5%, 1/4W	81349	RC07GF752J 5905-682-4101	16750079-054	1		
6-9		R27	RESISTOR, FIXED, METAL FILM, 3.48K OHMS, +-1%, 1/8W	81349	RN55C3481F 5905-959-6637	16757165-253	1		
6-9		R28	RESISTOR,FIXED,METAL FILM,17.4K OHMS,+-1%,1/8W	81349	RN55C1742F 5905-975-1663	16757165-324	1		
6-9		R29	RESISTOR, FIXED, CARBON COMPOSITION, 30K OHMS, +-5%, 1/4W	81349	RC07GF303J 5905-803-2908	16750079-068	1		
6-9		R30	RESISTOR, FIXED, CARBON COMPOSITION, 7.5K OHMS, +-5%, 1/4W	81349	RC07GF752J 5905-682-4101	16750079-054	1		
6-9		R31	RESISTOR, FIXED, METAL FILM, 475 OHMS, +-1%, 1/8W	81349	RN55C4750F 5905-982-0209	16757165-166	1		
6-9		R32	RESISTOR, FIXED, METAL FILM, 324 OHMS, +-1%, 1/8W	81349	RN55C3240F 5905-027-0545	16757165-150	1		
6-9		R33	RESISTOR,FIXED,CARBON COMPOSITION 5.1K OHMS,+-5%,1/4W	81349	RC07GF512J 5905-683-2241	16750079-050	1		
6-9		R34	RESISTOR,FIXED,CARBON COMPOSITION 22 OHMS,+-5%,1/4W	81349	RC07GF220J 5905-755-8389	16750079-166	1		
6-9		R35	RESISTOR, FIXED,CARBON COMPOSITION, 100OHMS, +/-5%, 1W	81349	RC32GF101J 5905-279-2643	16750077-539	1		
6-9		R36	RESISTOR,FIXED,CARBON COMPOSITION 56 OHMS,+-5%,1/2W	81349	RC20GF560J 5905-279-1897	16750076-519	1		
6-9		R37	RESISTOR,FIXED,CARBON COMPOSITION 5.1K OHMS,+-5%,1/4W	81349	RC07GF512J 5905-683-2241	16750079-050	1		

NOTES

TABLE 6-9. CLOCK CIRCUIT CARD ASSEMBLY (SHEET 4 OF 6)

FIGURE NUMBER	INDEX NUMBER	REFERENCE DESIGNATOR	DESCRIPTION 1 2 3 4 5 6 7	MANUFACTURER'S CODE	MANUFACTURER'S PART NUMBER / FEDERAL STOCK NUMBER	HONEYWELL PART NUMBER	QUANTITY PER ASSEMBLY	USABLE ON CODE	NOTES
6-9		R38	. RESISTOR,FIXED,CARBON COMPOSITION 24K OHMS,+-5%,1/4W	81349	RC07GF243J 5905-721-0597	16750079-066	1		
6-9		R39	. RESISTOR,FIXED,CARBON COMPOSITION 22MEGOHMS,+-5%,1/4W	81349	RC07GF226J 5905-835-2415	16750079-137	1		
6-9		R40	. RESISTOR, FIXED, METAL FILM, 16.9K OHMS, +-1%, 1/8W	81349	RN55C1692F 5905-928-8159	16757165-323	1		
6-9		R41	. RESISTOR, FIXED, METAL FILM, 13.3K OHMS, +-1%, 1/8W	81349	RN55C1332F 5905-992-5341	16757165-313	1		
6-9		R42	. RESISTOR,FIXED,CARBON COMPOSITION 5.6K OHMS,+-5%,1/4W	81349	RC07GF562J 5905-691-0195	16750079-051	1		
6-9		R43,R44	. RESISTOR,FIXED,CARBON COMPOSITION 27K OHMS,+-5%,1/4W	81349	RC07GF273J 5905-686-3838	16750079-067	2		
6-9		R45	. RESISTOR,VARIABLE,20K OHMS,+-10%, 3/4W	73138	79PR20K 5905-104-0726	16765947-011	1		
6-9		R46	. RESISTOR,VARIABLE,10K OHMS,+-10%, 3/4W	73138	79PR10K 5905-102-5886	16765947-010	1		
6-9		R47	. RESISTOR,FIXED,CARBON COMPOSITION 27K OHMS,+-5%,1/4W	81349	RC07GF273J 5905-686-3838	16750079-067	1		
6-9		R48	. RESISTOR,FIXED,CARBON COMPOSITION 20K OHMS,+-5%,1/4W	81349	RC07GF203J 5905-686-3368	16750079-064	1		
6-9		R49	. RESISTOR,FIXED,CARBON COMPOSITION 75K OHMS,+-5%,1/4W	81349	RC07GF753J 5905-800-3478	16750079-078	1		
6-9		R50	. RESISTOR, FIXED, METAL FILM, 8.45K OHMS, +-1%, 1/8W	81349	RN55C8451F 5905-836-9827	16757165-290	1		
6-9		R51	. RESISTOR,VARIABLE,5K OHMS,+-10%, 3/4W	73138	79PR5K 5905-104-0727	16765947-009	1		
6-9		R52	. RESISTOR, FIXED, METAL FILM, 6.19K OHMS, +-1%, 1/8W	81349	RN55C6191F 5905-982-0203	16757165-277	1		
6-9		R53	. RESISTOR,FIXED,CARBON COMPOSITION 20K OHMS,+-5%,1/4W	81349	RC07GF203J 5905-686-3368	16750079-064	1		
6-9		R54	. RESISTOR,FIXED,CARBON COMPOSITION 2.7MEGOHMS,+-5%,1/4W	81349	RC07GF275J 5905-810-2779	16750079-115	1		
6-9		R55	. RESISTOR,FIXED,CARBON COMPOSITION 100 OHMS,+-5%,1/4W	81349	RC07GF101J 5905-683-7721	16750079-009	1		
6-9		R56	. RESISTOR, FIXED, CARBON COMPOSITION, 5.1 MEG OHMS, +-5%, 1/4W	81349	RC07GF515J 5905-826-5463	16750079-122	1		
6-9		R57,R58	. RESISTOR, FIXED, CARBON COMPOSITION, 560 OHMS, +-5%, 1/4W	81349	RC07GF561J 5905-682-4109	16750079-027	2		
6-9		R59	. RESISTOR,FIXED,CARBON COMPOSITION 150 OHMS,+-5%,1/4W	81349	RC07GF151J 5905-683-2243	16750079-013	1		
6-9		R60,R61	. RESISTOR, FIXED, METAL FILM, 82.5K OHMS, +-5%, 1/8W	81349	RN55C8252F 5905-982-0192	16757165-389	2		
6-9		R62	. RESISTOR,FIXED,CARBON COMPOSITION 2K OHMS,+-5%,1/4W	81349	RC07GF202J 5905-686-3370	16750079-040	1		
6-9		R63,R64	. RESISTOR,FIXED,CARBON COMPOSITION 4.3K OHMS,+-5%,1/4W	81349	RC07GF432J 5905-682-4099	16750079-048	2		
6-9		R65	. RESISTOR, FIXED, METAL FILM, 10.7K OHMS, 0.1%, 1/4W	75042	CCAT9-1072B	16800403-304	1		
6-9		R66	. RESISTOR, FIXED, METAL FILM, 3.57K OHMS, 0.1%, 1/4W	75042	CCAT9-3571B	16800403-254	1		
6-9		R67	. RESISTOR, FIXED, METAL FILM, 10.7K OHMS, 0.1%, 1/4W	75042	CCAT9-1072B	16800403-304	1		

NOTES

TABLE 6-9. CLOCK CIRCUIT CARD ASSEMBLY (SHEET 5 OF 6)

FIGURE NUMBER	INDEX NUMBER	REFERENCE DESIGNATOR	DESCRIPTION 1 2 3 4 5 6 7	MANUFACTURER'S CODE	MANUFACTURER'S PART NUMBER / FEDERAL STOCK NUMBER	HONEYWELL PART NUMBER	QUANTITY PER ASSEMBLY	USABLE ON CODE	NOTES
6-9		R68	. RESISTOR, FIXED, METAL FILM, 3.57K OHMS, 0.1%, 1/4W	75042	CCAT9-3571B	16800403-254	1		
6-9		R69,R70	. RESISTOR,FIXED,CARBON COMPOSITION 2.7K OHMS,+-5%,1/4W	81349	RC07GF272J 5905-686-3798	16750079-043	2		
6-9		R71,R72	. RESISTOR,FIXED,CARBON COMPOSITION 6.2KOHMS,+-5%,1/4W	81349	RC07GF622J 5905-682-4100	16750079-052	2		
6-9		R73	. RESISTOR,FIXED,CARBON COMPOSITION 10K OHMS,+-5%,1/4W	81349	RC07GF103J 5905-683-2238	16750079-057	1		
6-9		R74,R75	. RESISTOR,FIXED,CARBON COMPOSITION 27K OHMS,+-5%,1/4W	81349	RC07GF273J 5905-686-3838	16750079-067	2		
6-9		R76	. RESISTOR, FIXED, CARBON COMPOSITION, 100 MEG OHMS, +-5%, 1/4W	81349	RC07GF107J	16750079-501	1		
6-9		R77	. RESISTOR, FIXED, METAL FILM, 1.30K OHMS, +-1%, 1/8W	81349	RN55C1301F 5905-975-4317	16757165-212	1		
6-9		R78	. RESISTOR,FIXED,CARBON COMPOSITION 16K OHMS,+-5%,1/4W	81349	RC07GF163J 5905-752-3186	16750079-062	1		
6-9		R79	. RESISTOR,FIXED,CARBON COMPOSITION 10K OHMS,+-5%,1/4W	81349	RC07GF103J 5905-683-2238	16750079-057	1		
6-9		R80	. RESISTOR, FIXED, METAL FILM, 3.57K OHMS, +-1%, 1/8W	81349	RN55C3571F 5905-985-5809	16757165-254	1		
6-9		R81	. RESISTOR, FIXED, METAL FILM, 4.99K, +-1%, 1/8W	81349	RN55C4991F 5905-913-6325	16757165-268	1		
6-9		R82	. RESISTOR,VARIABLE,20K OHMS,+-10%, 3/4W	73138	79PR20K 5905-104-0726	16765947-011	1		
6-9		R83	. RESISTOR, FIXED, METAL FILM, 243K OHMS, +-1%, 1/8W	07716	CCMT0-2433F	16757165-438	1		
6-9		R84	. RESISTOR,FIXED,CARBON COMPOSITION 75K OHMS,+-5%,1/4W	81349	RC07GF753J 5905-800-3478	16750079-078	1		
6-9		R85	. RESISTOR,FIXED,CARBON COMPOSITION 5.1K OHMS,+-5%,1/4W	81349	RC07GF512J 5905-683-2241	16750079-050	1		
6-9		R86	. RESISTOR, FIXED, CARBON COMPOSITION, 56 OHMS, +-5%, 1/4W	81349	RC07GF560J 5905-682-4106	16750079-003	1		
6-9		U1	. INTEGRATED CIRCUIT,OPERATIONAL AMPLIFIER	27014	LM301AH	16771548-001	1		
6-9		U2-U5	. INTEGRATED CIRCUIT, OPERATIONAL AMPLIFIER (L741-1)	28009		04040505-001	4		
6-9		U6,U7	. INTEGRATED CIRCUIT, MONOSTABLE MULTIVIBRATOR	01295	SN74121N	16775639-001	2		
6-9		U8	. INTEGRATED CIRCUIT, OPERATIONAL AMPLIFIER (L741-1)	28009		04040505-001	1		
6-9		U9	. INTEGRATED CIRCUIT,OPERATIONAL AMPLIFIER	27014	LM301AH	16771548-001	1		
6-9		U10	. INTEGRATED CIRCUIT, FLIP FLOP	01295	SN7476N 5962-106-4285	16766919-003	1		
6-9		U11	. NOT USED						
6-9		U12	. INTEGRATED CIRCUIT, FLIP FLOP	01295	SN7476N 5962-106-4285	16766919-003	1		
6-9		U13	. INTEGRATED CIRCUIT,LOGIC GATE	01295	SN7400N 5962-865-4625	99000000-001	1		
6-9		U14	. INTEGRATED CIRCUIT,LOGIC GATE	01295	SN7410N 5962-865-4626	99000010-001	1		
6-9		U15,U16	. INTEGRATED CIRCUIT, DIFFERENTIAL COMPARATOR	07263	U5B771039X 5962-241-0667	16765537-001	2		

NOTES

TABLE 6-9. CLOCK CIRCUIT CARD ASSEMBLY (SHEET 6 OF 6)

FIGURE NUMBER	INDEX NUMBER	REFERENCE DESIGNATOR	DESCRIPTION 1 2 3 4 5 6 7	MANUFACTURER'S CODE	MANUFACTURER'S PART NUMBER / FEDERAL STOCK NUMBER	HONEYWELL PART NUMBER	QUANTITY PER ASSEMBLY	USABLE ON CODE	NOTES
6-9		U17	. INTEGRATED CIRCUIT, MONOSTABLE MULTIVIBRATOR	21989	U6A960159X	16771177-002	1		
6-9		U18,U19	. INTEGRATED CIRCUIT, OPERATIONAL AMPLIFIER (L741-1)	28009		04040505-001	2		
6-9		VR1	. SEMICONDUCTOR DEVICE, DIODE	04713	1N5232A	16774066-012	1		
6-9			. PRINTED WIRING BOARD, CLOCK	28009		16775705-006	1		

NOTES:

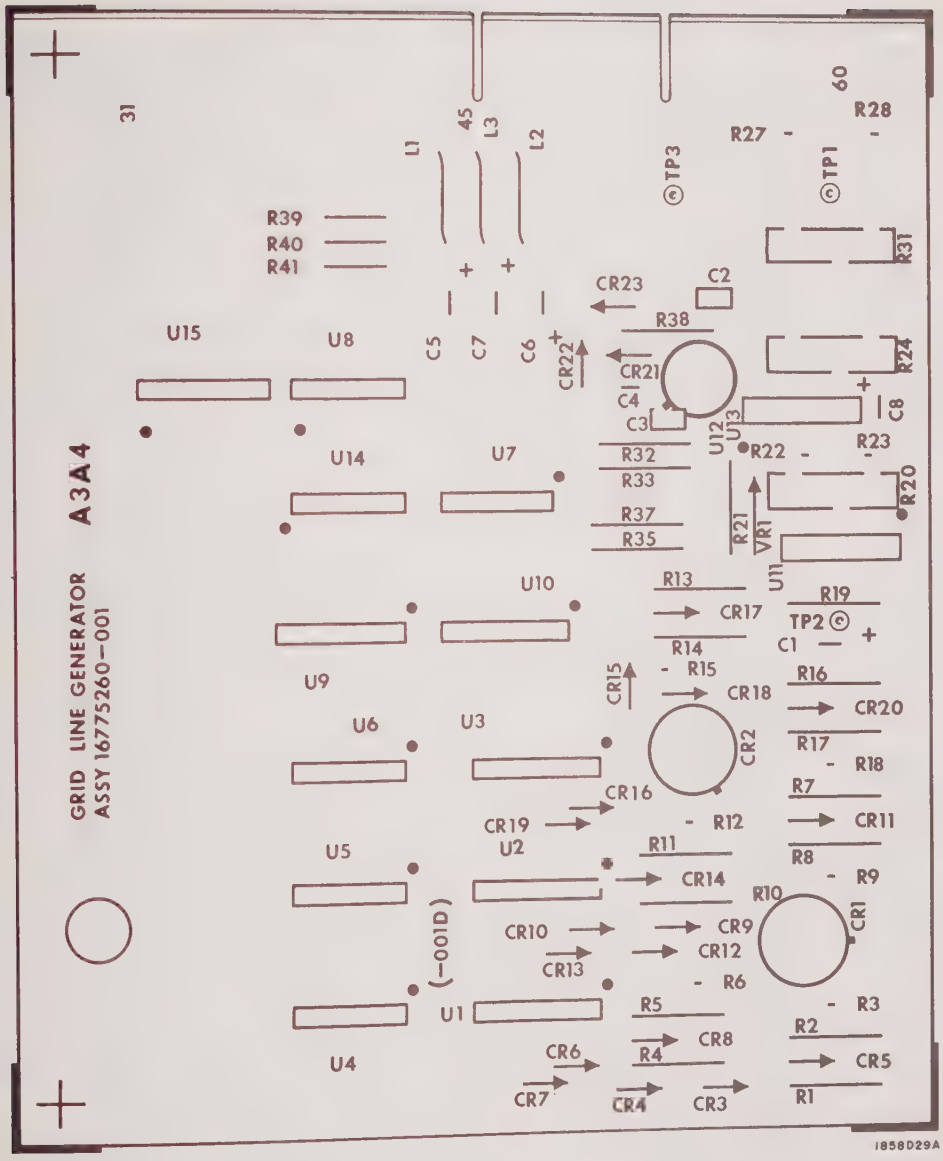


FIGURE 6-10. GRID LINE GENERATOR CIRCUIT CARD ASSEMBLY

TABLE 6-10. GRID LINE GENERATOR CIRCUIT CARD ASSEMBLY (SHEET 1 OF 3)

FIGURE NUMBER	INDEX NUMBER	REFERENCE DESIGNATOR	DESCRIPTION 1 2 3 4 5 6 7	MANUFACTURER'S CODE	MANUFACTURER'S PART NUMBER / FEDERAL STOCK NUMBER	HONEYWELL PART NUMBER	QUANTITY PER ASSEMBLY	USABLE ON CODE	NOTES
6-10		A3A4	CIRCUIT CARD ASSEMBLY, GRID LINE GENERATOR	28009		16775260-001	REF		
6-10			(SEE TABLE 6-4 FOR LOCATION IN NHA)						
6-10		CR1,CR2	• SEMICONDUCTOR DEVICE, DIODE ARRAY	86684	CA3039 5961-401-7768	16775734-001	2		
6-10		CR3-CR23	• SEMICONDUCTOR DEVICE,DIODE	81349	IN4148 5961-938-1135	16756865-003	21		
6-10		C1	• CAPACITOR, FIXED, ELECTROLYTIC, 100 UF, +-10%, 15 VDC	17554	C4110	16758058-904	1		
6-10		C2,C3	• CAPACITOR, FIXED, CERAMIC DIELECTRIC, 0.1 UF, +-20%, 50 VDC	72982	8121-050-651-104M	16771020-018	2		
6-10		C4	• CAPACITOR, FIXED, MICA, DIELECTRIC, 68UUF, +-5%, 500VDC	81349	CM05ED680J03	16761549-023	1		
6-10		C5,C6	• CAPACITOR, FIXED, ELECTROLYTIC, 100 UF, +-10%, 15 VDC	17554	C4110	16758058-904	2		
6-10		C7	• CAPACITOR, FIXED, ELECTROLYTIC, 180 UF, +-10 %, 6 VDC	17554	C4108	16758058-905	1		
6-10		C8	• CAPACITOR, FIXED, ELECTROLYTIC, 100 UF, +-10%, 15 VDC	17554	C4110	16758058-904	1		
6-10		L1-L3	• COIL,RADIO FREQUENCY	02114	VK200-10-3B 5950-832-4881	16773775-003	3		
6-10		R1	• RESISTOR, FIXED, METAL FILM 10K OHMS, +-1%, 1/8W	81349	RN55C1002F 5905-982-0937	16757165-301	1		
6-10		R2	• RESISTOR, FIXED, METAL FILM, 18.7K OHMS, +-1%, 1/8W	81349	RN55C1872F 5905-972-3434	16757165-327	1		
6-10		R3	• RESISTOR, FIXED, METAL FILM, 50K OHMS, +-0.1%,0.3W	18612	V53-1-50K-0.1PCT	16774606-023	1		
6-10		R4	• RESISTOR, FIXED, METAL FILM 10K OHMS, +-1%, 1/8W	81349	RN55C1002F 5905-982-0937	16757165-301	1		
6-10		R5	• RESISTOR, FIXED, METAL FILM 9.31K OHMS, +-1%, 1/8W	81349	RN55C9311F 5905-972-3596	16757165-294	1		
6-10		R6	• RESISTOR, FIXED, METAL FILM 25K OHMS, +-0.1%, 0.3W	18612	V53-1-25K-0.1PCT	16774606-024	1		
6-10		R7	• RESISTOR, FIXED, METAL FILM 10K OHMS, +-1%, 1/8W	81349	RN55C1002F 5905-982-0937	16757165-301	1		
6-10		R8	• RESISTOR, FIXED, METAL FILM, 4.64K OHMS, +-1%, 1/8W	81349	RN55C4641F 5905-975-1402	16757165-265	1		
6-10		R9	• RESISTOR, FIXED, METAL FILM, 12.5K OHMS, +-0.1%, 0.3W	18612	V53-1-12.5K-0.1PCT	16774606-025	1		
6-10		R10	• RESISTOR, FIXED, METAL FILM 10K OHMS, +-1%, 1/8W	81349	RN55C1002F 5905-982-0937	16757165-301	1		
6-10		R11	• RESISTOR, FIXED METAL FILM 2.32K OHMS, +-1%, 1/8W	81349	RN55C2321F 5905-944-9224	16757165-236	1		
6-10		R12	• RESISTOR, FIXED, METAL FILM, 6.25K OHMS, +-0.1%, 0.3W	18612	V53-1-6.25K-0.1PCT	16774606-026	1		
6-10		R13	• RESISTOR, FIXED, METAL FILM 10K OHMS, +-1%, 1/8W	81349	RN55C1002F 5905-982-0937	16757165-301	1		
6-10		R14	• RESISTOR, FIXED, METAL FILM, 1.15K OHMS, +-1%, 1/8W	81349	RN55C1151F 5905-975-4316	16757165-207	1		
6-10		R15	• RESISTOR, FIXED, METAL FILM, 3.125K OHMS, +-0.1%, 0.3W	18612	V53-1-3.125K-0.PCT	16774606-027	1		
6-10		R16	• RESISTOR, FIXED, METAL FILM 10K OHMS, +-1%, 1/8W	81349	RN55C1002F 5905-982-0937	16757165-301	1		

NOTES

TABLE 6-10. GRID LINE GENERATOR CIRCUIT CARD ASSEMBLY (SHEET 2 OF 3)

FIGURE NUMBER	INDEX NUMBER	REFERENCE DESIGNATOR	DESCRIPTION 1 2 3 4 5 6 7	MANUFACTURER'S CODE	MANUFACTURER'S PART NUMBER / FEDERAL STOCK NUMBER	HONEYWELL PART NUMBER	QUANTITY PER ASSEMBLY	USABLE ON CODE	NOTES
6-10		R17	• RESISTOR, FIXED, METAL FILM, 1.15K OHMS, +-1%, 1/8W	81349	RNR55K1151FM	16757165-207	1		
6-10		R18	• RESISTOR, FIXED, METAL FILM, 3.125K OHMS, +-0.1%, 0.3W	18612	V53-1-3.125K-0.PCT	16774606-027	1		
6-10		R19	• RESISTOR, FIXED, METAL FILM, 6.65K OHMS, +-1%, 1/8W	81349	RNR55K6651FM	16757165-280	1		
6-10		R20	• RESISTOR, VARIABLE, 1K OHMS, +-10%, 3/4 W	73138	79PR1K 5905-193-6861	16765947-007	1		
6-10		R21	• RESISTOR, FIXED, METAL FILM 1.62K OHMS, +-1%, 1/8W	81349	RNR55K1621FM	16757165-221	1		
6-10		R22	• RESISTOR, FIXED, METAL FILM 20K OHMS, +-0.1%, 0.3W	18612	V53-1-20K-0.1PCT	16774606-028	1		
6-10		R23	• RESISTOR, FIXED, METAL FILM, 12.5K OHMS, +-0.1%, 0.3W	18612	V53-1-12.5K-0.1PCT	16774606-025	1		
6-10		R24	• RESISTOR, VARIABLE, 500 OHMS, +-10%, 3/4W	73138	79PR500 5905-498-1963	16765947-006	1		
6-10		R25,R26	• NOT USED						
6-10		R27,R28	• RESISTOR, FIXED, METAL FILM, 1.4K OHMS, +-0.1%, 0.3W	18612	V53-1-1.4K-0.1PCT	16774606-029	2		
6-10		R29,R30	• NOT USED						
6-10		R31	• RESISTOR, VARIABLE, 500 OHMS, +-10%, 3/4 W	73138	89PR500	16775165-006	1		
6-10		R32	• RESISTOR, FIXED, METAL FILM, 7.5K OHMS, +-1%, 1/8W	81349	RNR55K7501FM	16757165-285	1		
6-10		R33	• RESISTOR, FIXED, METAL FILM 866 OHMS, +-1%, 1/8W	81349	RNR55K8660FM	16757165-191	1		
6-10		R34	• NOT USED						
6-10		R35	• RESISTOR, FIXED, METAL FILM 2.49K OHMS, +-1%, 1/8W	81349	RNR55K2491FM	16757165-239	1		
6-10		R36	• NOT USED						
6-10		R37	• RESISTOR, FIXED, METAL FILM, 4.64K OHMS, +-1%, 1/8W	81349	RNR55K4641FM	16757165-265	1		
6-10		R38	• RESISTOR, FIXED, METAAL FILM 2.21K OHMS, +-1%, 1/8W	81349	RNR55K2211FM	16757165-234	1		
6-10		R39-R41	• RESISTOR, FIXED, CARBON COMPOSITION, 4.3K OHMS, +-5%, 1/4W	81349	RCR07G432JM	16750079-048	3		
6-10		TP1-TP3	• TERMINAL, QUICK DISCONNECT	00779	60809-2	16767598-006	3		
6-10		U1-U3	• INTEGRATED CIRCUIT, FLIP FLOP	01295	SN7476N 5962-106-4285	16766919-003	3		
6-10		U4	• INTEGRATED CIRCUIT,LOGIC GATE	01295	SN7400N 5962-865-4625	99000000-001	1		
6-10		U5	• INTEGRATED CIRCUIT,HEX INVERTER	01295	SN7404N 5962-404-2259	99000004-001	1		
6-10		U6	• INTEGRATED CIRCUIT,LOGIC GATE	01295	SN7400N 5962-865-4625	99000000-001	1		
6-10		U7	• INTEGRATED CIRCUIT,LOGIC GATE	01295	SN7410N 5962-865-4626	99000010-001	1		
6-10		U8	• INTEGRATED CIRCUIT, LOGIC GATE	01295	SN7440N 5962-185-3806	99000013-001	1		
6-10		U9,U10	• INTEGRATED CIRCUIT, FLIP FLOP	01295	SN7476N 5962-106-4285	16766919-003	2		

NOTES:

TABLE 6-10. GRID LINE GENERATOR CIRCUIT CARD ASSEMBLY (SHEET 3 OF 3)

FIGURE NUMBER	INDEX NUMBER	REFERENCE DESIGNATOR	DESCRIPTION 1 2 3 4 5 6 7	MANUFACTURER'S CODE	MANUFACTURER'S PART NUMBER / FEDERAL STOCK NUMBER	HONEYWELL PART NUMBER	QUANTITY PER ASSEMBLY	USABLE ON CODE	NOTES
6-10		U11	• INTEGRATED CIRCUIT, OPERATIONAL AMPLIFIER	04713	L741-1	04040505-001	1		
6-10		U12	• INTEGRATED CIRCUIT COMPARATOR	27014	LM306H	16765537-021	1		
6-10		U13	• INTEGRATED CIRCUIT, OPERATIONAL AMPLIFIER	04713	L741-1	04040505-001	1		
6-10		U14	• INTEGRATED CIRCUIT,LOGIC GATE	01295	SN7410N 5962-A65-4626	99000010-001	1		
6-10		U15	• INTEGRATED CIRCUIT, FLIP FLOP	01295	SN7476N 5962-106-4285	16766919-003	1		
6-10			• PRINTED WIRING BOARD	28009		16775259-001	1		

NOTES:

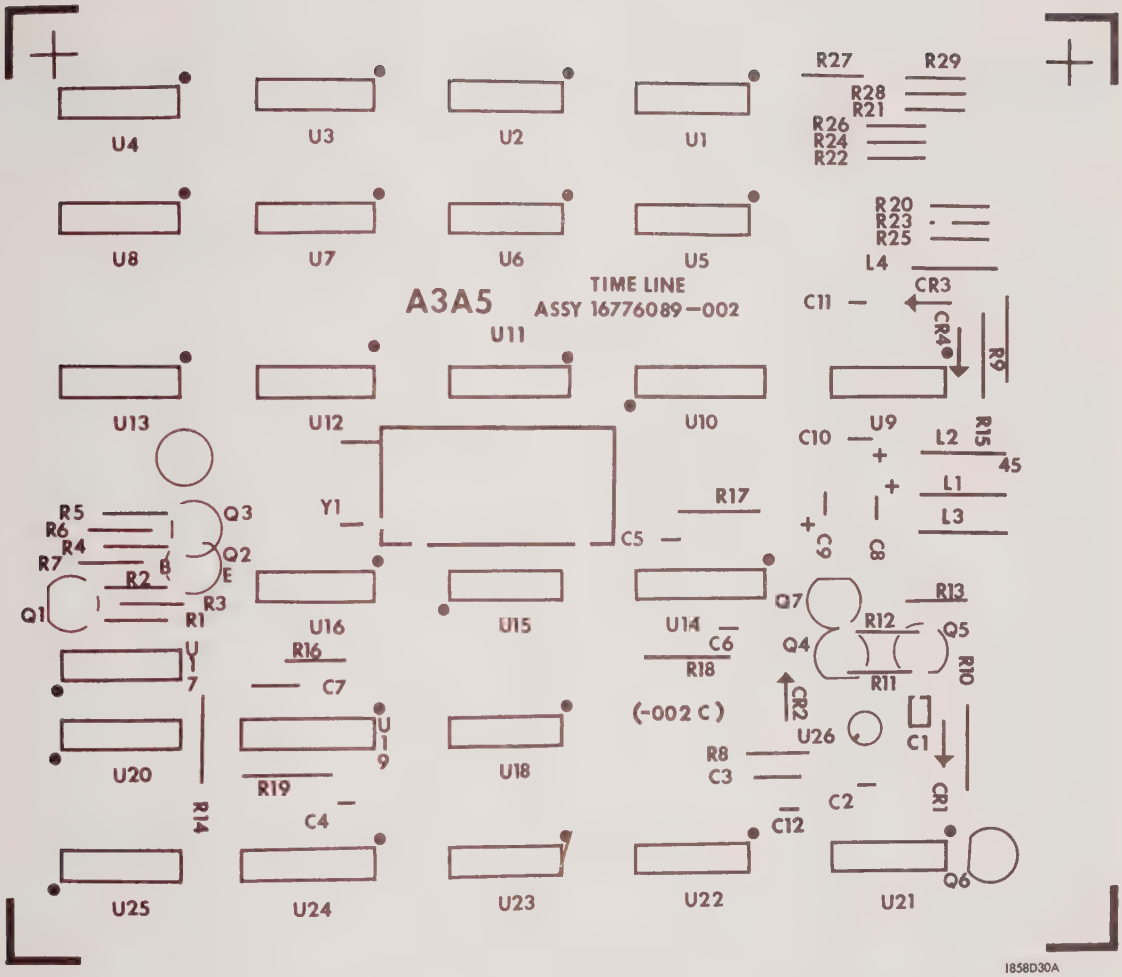


FIGURE 6-11. TIME LINE CIRCUIT CARD ASSEMBLY

TABLE 6-11. TIME LINE CIRCUIT CARD ASSEMBLY (SHEET 1 OF 3)

FIGURE NUMBER	INDEX NUMBER	REFERENCE DESIGNATOR	DESCRIPTION 1 2 3 4 5 6 7	MANUFACTURER'S CODE	MANUFACTURER'S PART NUMBER / FEDERAL STOCK NUMBER	HONEYWELL PART NUMBER	QUANTITY PER ASSEMBLY	USABLE ON CODE	NOTES
6-11		A345	CIRCUIT CARD ASSEMBLY, TIME LINE	2■009		16776089-002	REF		
6-11			(SEE TABLE 6-4 FOR LOCATION IN NHA)						
6-11		CR1-CR4	. SEMICONDUCTOR DEVICE,DIODE	81349	1N4148 5961-938-1135	16756865-003	4		
6-11		C1	. CAPACITOR, FIXED, CERAMIC DIELECTRIC, 0.1 UF, +-20%, 50 VDC	72982	8121-050-651-104M	16771020-018	1		
6-11		C2	. CAPACITOR, FIXED, MICA, DIELECTRIC, 150UUF, +-5%, 500VDC	81349	CM05FD151J03	16761549-031	1		
6-11		C3	. CAPACITOR,FIXED,PLASTIC DIELECTRIC,0.047UF,+-5%,50VDC	01002	75F1R5C473 5910-127-2212	16763563-226	1		
6-11		C4	. CAPACITOR, FIXED, MICA, DIELECTRIC, 180UUF, +-5%, 500VDC	81349	CM05FD181J03 5910-453-8796	16761549-033	1		
6-11		C5,C6	. CAPACITOR, FIXED, MICA, DIELECTRIC, 15UUF, +-5%, 500VDC	81349	CM05CD150J03 5910-936-7405	16761549-104	2		
6-11		C7	. CAPACITOR, FIXED, PLASTIC, DIELECTRIC, 0.015UF, +-10%, 50VDC	06001	75F1R5A153	16770744-220	1		
6-11		C8	. CAPACITOR, FIXED, ELECTROLYTIC, 100 UF, +-10%, 15 VDC	17554	C4110	16758058-904	1		
6-11		C9	. CAPACITOR, FIXED, ELECTROLYTIC, 180 UF, +-10 %, 6 VDC	17554	C4108	16758058-905	1		
6-11		C10	. CAPACITOR, FIXED, ELECTROLYTIC, 100 UF, +-10%, 15 VDC	17554	C4110	16758058-904	1		
6-11		C11, C12	. CAPACITOR, FIXED, MICA, DIELECTRIC, 150UUF, +-5%, 500VDC	81349	CM05FD151J03	16761549-031	2		
6-11		L1-L4	. COIL,RADIO FREQUENCY	02114	VK200-10-3B 5950-832-4881	16773775-003	4		
6-11		Q1	. TRANSISTOR	80131	2N3904 5961-892-8706	16762172-002	1		
6-11		Q2	. TRANSISTOR	80131	2N3391 5961-931-0152	16761780-002	1		
6-11		Q3	. TRANSISTOR	80131	2N3904 5961-892-8706	16762172-002	1		
6-11		Q4	. TRANSISTOR	04713	2N3906 5961-072-0128	16762173-002	1		
6-11		Q5-Q7	. TRANSISTOR	80131	2N3904 5961-892-8706	16762172-002	3		
6-11		R1	. RESISTOR,FIXED,CARBON COMPOSITION 4.3K OHMS,+-5%,1/4W	81349	RC07GF432J 5905-682-4099	16750079-048	1		
6-11		R2	. RESISTOR, FIXED, METAAL FILM 2.21K OHMS, +-1%, 1/8W	81349	RN60C2211F 5905-809-8688	16757165-234	1		
6-11		R3	. RESISTOR, FIXED, METAL FILM, 14K OHMS, +-1%, 1/8 W	81349	RN60C1402F 5905-059-9117	16757165-315	1		
6-11		R4	. RESISTOR,FIXED,CARBON COMPOSITION 150K OHMS,+-5%,1/4W	81349	RC07GF154J 5905-686-9995	16750079-085	1		
6-11		R5	. RESISTOR,FIXED,CARBON COMPOSITION 75K OHMS,+-5%,1/4W	81349	RC07GF753J 5905-800-3478	16750079-078	1		
6-11		R6	. RESISTOR,FIXED,CARBON COMPOSITION 6.2KOHMS,+-5%,1/4W	81349	RC07GF622J 5905-682-4100	16750079-052	1		
6-11		R7	. RESISTOR, FIXED, CARBON COMPOSITION, 1.8K OHMS, +-5%, 1/4W	81349	RC07GF182J 5905-688-3738	16750079-039	1		
6-11		R8	. RESISTOR,FIXED,CARBON COMPOSITION 7.2K OHMS,+-5%,1/4W	81349	RC07GF222J 5905-723-5251	16750079-041	1		

NOTES

TABLE 6-11. TIME LINE CIRCUIT CARD ASSEMBLY (SHEET 2 OF 3)

FIGURE NUMBER	INDEX NUMBER	REFERENCE DESIGNATOR	DESCRIPTION 1 2 3 4 5 6 7	MANUFACTURER'S CODE	MANUFACTURER'S PART NUMBER / FEDERAL STOCK NUMBER	HONEYWELL PART NUMBER	QUANTITY PER ASSEMBLY	USABLE ON CODE	NOTES
6-11		R9,R10	. RESISTOR, FIXED, METAL FILM, 82.5K OHMS, +-5%, 1/8W	81349	RN55C8252F 5905-982-0192	16757165-389	2		
6-11		R11	. RESISTOR,FIXED,CARBON COMPOSITION 4.3K OHMS,+-5%,1/4W	81349	RC07GF432J 5905-682-4099	16750079-048	1		
6-11		R12	. RESISTOR,FIXED,CARBON COMPOSITION 33K OHMS,+-5%,1/4W	81349	RC07GF333J 5905-686-3903	16750079-069	1		
6-11		R13	. RESISTOR,FIXED,CARBON COMPOSITION 4.3K OHMS,+-5%,1/4W	81349	RC07GF432J 5905-682-4099	16750079-048	1		
6-11		R14	. RESISTOR,FIXED,FILM,7.5K OHMS, +-1%,1/8W	81349	RN55C7501F 5905-078-1712	16757165-285	1		
6-11		R15	. RESISTOR, FIXED, METAL FILM, 4.12K OHMS, +-1%, 1/8W	81349	RN55C4121F 5905-974-5595	16757165-260	1		
6-11		R16	. RESISTOR,FIXED,CARBON COMPOSITION 39K OHMS,+-5%,1/4W	81349	RC07GF393J 5905-686-3358	16750079-071	1		
6-11		R17,R18	. RESISTOR, FIXED, METAL FILM, 5.11K, +-1%, 1/8W	81349	RN55C5111F 5905-982-0930	16757165-269	2		
6-11		R19	. RESISTOR, FIXED, METAL FILM 10K OHMS, +-1%, 1/8W	81349	RN55C1002F 5905-982-0937	16757165-301	1		
6-11		R20,R21	. RESISTOR,FIXED,CARBON COMPOSITION 1.5K OHMS,+-5%,1/4W	81349	RC07GF152J 5905-683-7723	16750079-037	2		
6-11		R22	. RESISTOR,FIXED,CARBON COMPOSITION 2.2K OHMS,+-5%,1/4W	81349	RC07GF222J 5905-723-5251	16750079-041	1		
6-11		R23-R25	. RESISTOR,FIXED,CARBON COMPOSITION 4.3K OHMS,+-5%,1/4W	81349	RC07GF432J 5905-682-4099	16750079-048	3		
6-11		R26	. RESISTOR,FIXED,CARBON COMPOSITION 910 OHMS,+-5%,1/4W	81349	RC07GF911J 5905-801-6444	16750079-032	1		
6-11		R27-R29	. RESISTOR,FIXED,CARBON COMPOSITION 2.2K OHMS,+-5%,1/4W	81349	RC07GF222J 5905-723-5251	16750079-041	3		
6-11		U1,U2	. INTEGRATED CIRCUIT,LOGIC GATE	01295	SN7400N 5962-865-4625	99000000-001	2		
6-11		U3,U4	. INTEGRATED CIRCUIT,COUNTER,HIGH SPEED	01295	SN7490N 5962-102-7519	99000018-001	2		
6-11		U5	. INTEGRATED CIRCUIT,LOGIC GATE	01295	SN7410N 5962-865-4626	99000010-001	1		
6-11		U6,U7	. INTEGRATED CIRCUIT,LOGIC GATE	01295	SN7400N 5962-865-4625	99000000-001	2		
6-11		U8	. INTEGRATED CIRCUIT,COUNTER,HIGH SPEED	01295	SN7490N 5962-102-7519	99000018-001	1		
6-11		U9	. INTEGRATED CIRCUIT,LOGIC GATE	01295	SN7410N 5962-865-4626	99000010-001	1		
6-11		U10	. INTEGRATED CIRCUIT, SHIFT REGISTER	01295	SN7496N-00	16775376-001	1		
6-11		U11,U12	. INTEGRATED CIRCUIT,LOGIC GATE	01295	SN7400N 5962-865-4625	99000000-001	2		
6-11		U13	. INTEGRATED CIRCUIT,COUNTER,HIGH SPEED	01295	SN7490N 5962-102-7519	99000018-001	1		
6-11		U14	. INTEGRATED CIRCUIT, MONOSTABLE MULTIVIBRATOR	01295	SN74123N	16775377-001	1		
6-11		U15	. INTEGRATED CIRCUIT, LOGIC GATE	01295	SN7440N 5962-185-3806	99000013-001	1		
6-11		U16	. INTEGRATED CIRCUIT, LOGIC GATE	01295	SN7408N	99000008-001	1		
6-11		U17	. INTEGRATED CIRCUIT,COUNTER,HIGH SPEED	01295	SN7490N 5962-102-7519	99000018-001	1		

NOTES.

TABLE 6-11. TIME LINE CIRCUIT CARD ASSEMBLY (SHEET 3 OF 3)

FIGURE NUMBER	INDEX NUMBER	REFERENCE DESIGNATOR	DESCRIPTION 1 2 3 4 5 6 7	MANUFACTURER'S CODE	MANUFACTURER'S PART NUMBER / FEDERAL STOCK NUMBER	HONEYWELL PART NUMBER	QUANTITY PER ASSEMBLY	USABLE ON CODE	NOTES
6-11		U18	• INTEGRATED CIRCUIT, LOGIC GATE	01295	SN7408N	99000008-001	1		
6-11		U19	• INTEGRATED CIRCUIT, MONOSTABLE MULTIVIBRATOR	01295	SN74123N	16775377-001	1		
6-11		U20	• INTEGRATED CIRCUIT,COUNTER,HIGH SPEED	01295	SN7490N 5962-102-7519	99000018-001	1		
6-11		U21	• INTEGRATED CIRCUIT,LOGIC GATE	01295	SN7400N 5962-865-4625	99000000-001	1		
6-11		U22	• INTEGRATED CIRCUIT,COUNTER,HIGH SPEED	01295	SN7490N 5962-102-7519	99000018-001	1		
6-11		U23	• INTEGRATED CIRCUIT,LOGIC GATE	01295	SN7400N 5962-865-4625	99000000-001	1		
6-11		U24	• INTEGRATED CIRCUIT, SHIFT REGISTER	01295	SN7496N-00	16775376-001	1		
6-11		U25	• INTEGRATED CIRCUIT,LOGIC GATE	01295	SN7410N 5962-865-4626	99000010-001	1		
6-11		U26	• INTEGRATED CIRCUIT,OPERATIONAL AMPLIFIER	27014	LM301AH	16771548-001	1		
6-11		Y1	• CRYSTAL UNIT	28009		16764780-002	1		
6-11			• STRAP,TIEDOWN,ELECTRICAL COMPONENTS	98159	2829-75-1 5330-873-3450	16755973-001	2		
6-11			• PRINTED WIRING BOARD	28009		16775375-002	1		

NOTES

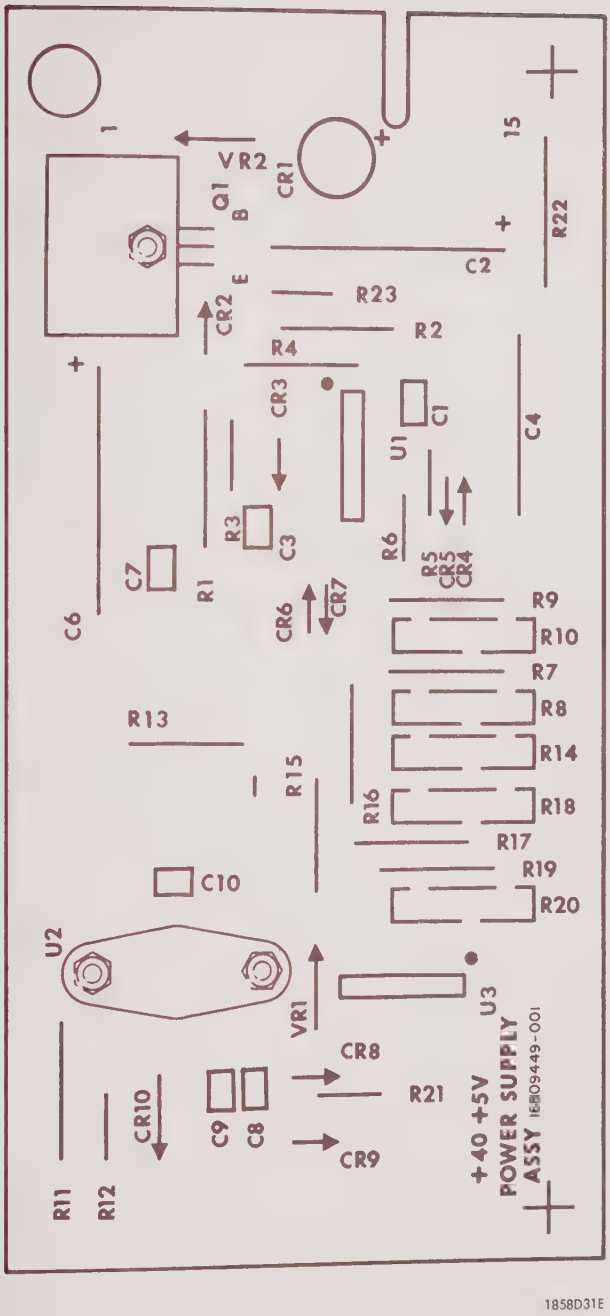


FIGURE 6-12. +40V AND +5V POWER SUPPLY CIRCUIT CARD ASSEMBLY

TABLE 6-12. +40V AND +5V POWER SUPPLY CIRCUIT CARD ASSEMBLY (SHEET 1 OF 2)

FIGURE NUMBER	INDEX NUMBER	REFERENCE DESIGNATOR	DESCRIPTION 1 2 3 4 5 6 7	MANUFACTURER'S CODE	MANUFACTURER'S PART NUMBER / FEDERAL STOCK NUMBER	HONEYWELL PART NUMBER	QUANTITY PER ASSEMBLY	USABLE ON CODE	NOTES
6-12		A3A6	CIRCUIT CARD ASSEMBLY, +40V AND +5V POWER SUPPY (SEE TABLE 6-4 FOR LOCATION IN NHA)	28009		16809449-001	REF		
6-12		CR1	. SEMICONDUCTOR DEVICE,DIODE	14936	W02	16759755-002	1		
6-12		CR2-CR9	. SEMICONDUCTOR DEVICE, DIODE	14433	1N4148	16756865-003	8		
6-12		CR10	. SEMICONDUCTOR DEVICE, DIODE	04713	1N4002 5961-880-4783	16756961-002	1		
6-12		C1	. CAPACITOR, FIXED, CERAMIC DIELECTRIC, 0.1 UF, +-20%, 50 VDC	72982	8121-050-651-104M	16771020-018	1		
6-12		C2	. CAPACITOR, FIXED, ELECTROLYTIC, 150UF, +50%/-10%, 40VDC	80031	ET151X040A00	16758518-313	1		
6-12		C3	. CAPACITOR,FIXED,CERAMIC DIELECTRIC,1000UUF,+-20%,50VDC	72982	8101-050-651-102M	16771020-003	1		
6-12		C5	. NOT USED						
6-12		C6	. CAPACITOR, FIXED, ELECTROLYTIC, 100UF, +50%/-10%, 63	80031	ET101X063A01	16758518-362	1		
6-12		C7	. CAPACITOR, FIXED, CERAMIC DIELECTRIC, 0.1UF, +-20%, 100VDC	72982	8121-100-651-104M	16771020-218	1		
6-12		C8	. CAPACITOR, FIXED, CERAMIC DIELECTRIC, 0.1 UF, +-20%, 50 VDC	72982	8121-050-651-104M	16771020-018	1		
6-12		C9	. CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.01UF, +-20%, 50VDC	72982	8121-050-651-103M	16771020-011	1		
6-12		C10	. CAPACITOR, FIXED, CERAMIC DIELECTRIC, 0.1 UF, +-20%, 50 VDC	72982	8121-050-651-104M	16771020-018	1		
6-12		Q1	. TRANSISTOR	04713	2N4923 5961-105-7636	16766748-006	1		
6-12			. HEAT SINK	98978	PA2-1CB 5961-469-7449	16774665-003	1		
6-12		R1	. RESISTOR,FIXED,WIREWOUND,0.68 OHMS,+-5%,2W	75042	BWHR68J 5905-402-1058	16756611-204	1		
6-12		R2	. RESISTOR, FIXED, METAL FILM, 1K OHMS, +-1%, 1/4W	81349	RNR60K1001FM	16757161-201	1		
6-12		R3	. RESISTOR, FIXED, CARBON COMPOSITION, 1.2K OHMS, +-5%, 1/4W	81349	RCR07G122JM	16750079-035	1		
6-12		R4	. RESISTOR, FIXED, METAL FILM, 8.66K OHMS, +-1%, 1/4W	81349	RNR60K8661FM	16757161-291	1		
6-12		R5	. RESISTOR, FIXED, CARBON COMPOSITION, 91K OHMS, +-5%, 1/4W	81349	RCR07G913JM	16750079-080	1		
6-12		R6	. RESISTOR, FIXED, CARBON COMPOSITION, 1K OHMS, +-5%, 1/4W	81349	RCR07GF102JM 5905-00-110-7620	16750079-033	1		
6-12		R7	. RESISTOR, FIXED, METAL FILM, 33.2K OHMS, +-1%, 1/4W	81349	RNR60K3322FM	16757161-351	1		
6-12		R8	. RESISTOR,VARIABLE,20K OHMS,+-10%, 3/4W	73138	79PR20K 5905-104-0726	16765947-011	1		
6-12		R9	. RESISTOR, FIXED, METAL FILM, 47.5K OHMS, +-1%, 1/4W	81349	RNR60K4752FM	16757161-366	1		
6-12		R10	. RESISTOR,VARIABLE,50K OHMS,+-10%, 3/4W	73138	79PR50K 5905-122-3806	16765947-013	1		

NOTES:

TABLE 6-12. +40V AND +5V POWER SUPPLY CIRCUIT CARD ASSEMBLY (SHEET 2 OF 2)

FIGURE NUMBER	INDEX NUMBER	REFERENCE DESIGNATOR	DESCRIPTION 1 2 3 4 5 6 7	MANUFACTURER'S CODE	MANUFACTURER'S PART NUMBER / FEDERAL STOCK NUMBER	HONEYWELL PART NUMBER	QUANTITY PER ASSEMBLY	USABLE ON CODE	NOTES
6-12		R11	• RESISTOR, FIXED, CARBON COMPOSITION, 47 OHMS, +-5%, 1W	81349	RCR32G470JM	16750077-531	1		
6-12		R12	• RESISTOR, FIXED, CARBON COMPOSITION, 51 OHMS, +-5%, 1/4W	81349	RCR07G510JM	16750079-002	1		
6-12		R13	• RESISTOR, FIXED, METAL FILM, 2.15K OHMS, +-1%, 1/4W	81349	RNR60K2151FM	16757161-233	1		
6-12		R14	• RESISTOR,VARIABLE,2K OHMS,+-10%, 3/4W	73138	79PR2K 5905-104-0725	16765947-008	1		
6-12		R15	• RESISTOR, FIXED, METAL FILM, 6.81K OHMS, +-1%, 1/4W	81349	RNR60K6811FM	16757161-281	1		
6-12		R16	• RESISTOR, FIXED, METAL FILM, 49.9 OHMS, +-1%, 1/4W	81349	RNR60K49R9FM	16757161-068	1		
6-12		R17	• RESISTOR, FIXED, METAL FILM, 2.49K OHMS, +-1%, 1/4W	81349	RNR60K2491FM	16757161-239	1		
6-12		R18	• RESISTOR,VARIABLE,5K OHMS,+-10%, 3/4W	73138	79PR5K 5905-104-0727	16765947-009	1		
6-12		R19	• RESISTOR, FIXED, METAL FILM, 90.9K OHMS, +-1%, 1/4W	81349	RNR60K9092FM	16757161-393	1		
6-12		R20	• RESISTOR,VARIABLE,10K OHMS,+-10%, 3/4W	73138	79PR10K 5905-102-5886	16765947-010	1		
6-12		R21	• RESISTOR, FIXED, CARBON COMPOSITION, 4.7K OHMS, +-5%, 1/4W	81349	RCR07G472JM	16750079-049	1		
6-12		R22	• RESISTOR, FIXED, CARBON COMPOSITION, 1.8K OHMS, +-5%, 1W	81349	RCR32G182JM	16750077-569	1		
6-12		R23	• RESISTOR, FIXED, CARBON COMPOSITION, 100 OHMS, +-5%, 1/4W	81349	RCR07G101JM	16750079-009	1		
6-12		U1	• INTEGRATED CIRCUIT, VOLTAGE REGULATOR	04713	MC1466L	16775737-001	1		
6-12		U2	• INTEGRATED CIRCUIT,VOLTAGE REGULATOR	04713	MC1469R	16770480-014	1		
6-12		U3	• INTEGRATED CIRCUIT, OPERATIONAL AMPLIFIER	28009		04040505-001	1		
6-12		VR1	• SEMICONDUCTOR DEVICE, DIODE	04713	1N5234B	16774066-114	1		
6-12		VR2	• SEMICONDUCTOR DEVICE, DIODE	80131	1N4738A 5961-00-989-9522	16737938-111	1		

NOTES

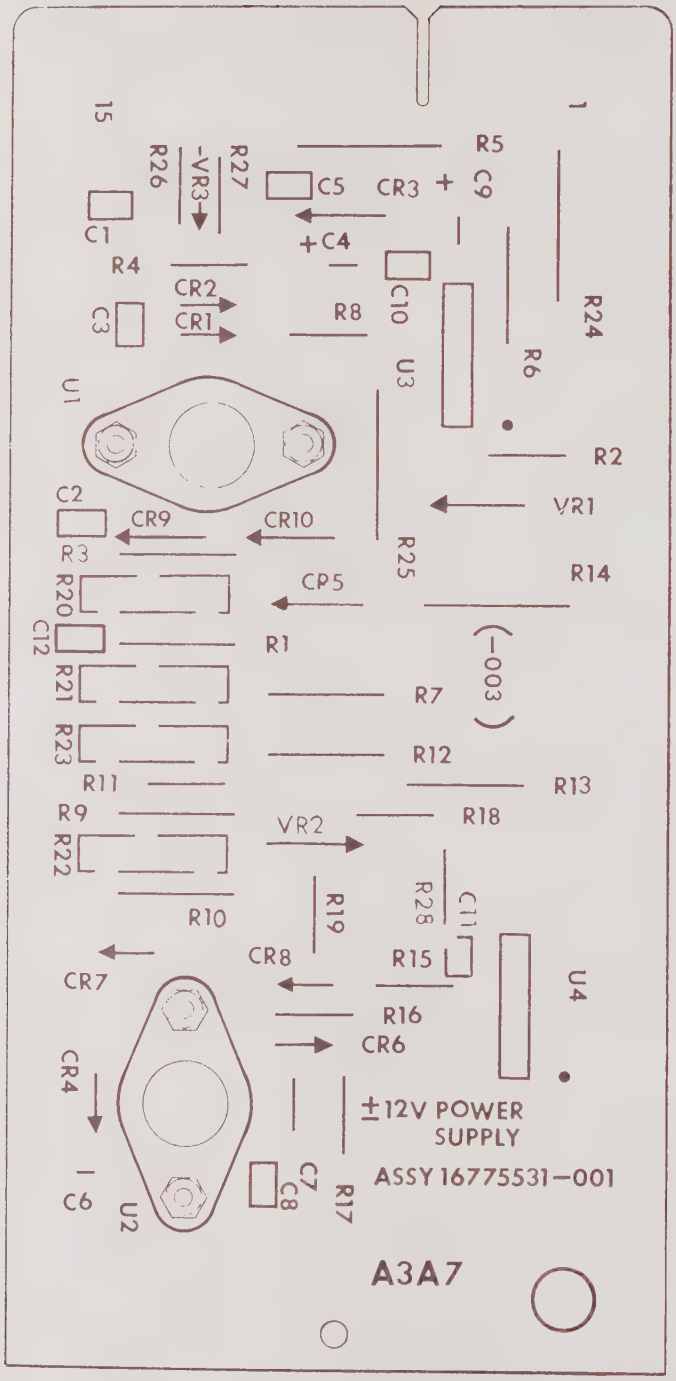


FIGURE 6-13. +-12V POWER SUPPLY CIRCUIT CARD ASSEMBLY

TABLE 6-13. +-12V POWER SUPPLY CIRCUIT CARD ASSEMBLY (SHEET 1 OF 2)

FIGURE NUMBER	INDEX NUMBER	REFERENCE DESIGNATOR	DESCRIPTION 1 2 3 4 5 6 7	MANUFACTURER'S CODE	MANUFACTURER'S PART NUMBER / FEDERAL STOCK NUMBER	HONEYWELL PART NUMBER	QUANTITY PER ASSEMBLY	USABLE ON CODE	NOTES
6-13		A3A7	CIRCUIT CARD ASSEMBLY, +-12V POWER SUPPLY (SEE TABLE 6-4 FOR LOCATION IN NHA)	28009		16775531-001	REF		
6-13		CR1,CR2	. SEMICONDUCTOR DEVICE, DIODE	14433	1N4148	16756865-003	2		
6-13		CR3	. SEMICONDUCTOR DEVICE, DIODE	04713	1N4002 5961-880-4783	16756961-002	1		
6-13		CR4	. SEMICONDUCTOR DEVICE, DIODE	14433	1N4148	16756865-003	1		
6-13		CR5	. SEMICONDUCTOR DEVICE, DIODE	04713	1N4002 5961-880-4783	16756961-002	1		
6-13		CR6-CR8	. SEMICONDUCTOR DEVICE, DIODE	14433	1N4148	16756865-003	3		
6-13		CR9,CR10	. SEMICONDUCTOR DEVICE, DIODE	04713	1N4002 5961-880-4783	16756961-002	2		
6-13		C1,C2	. CAPACITOR, FIXED, CERAMIC DIELECTRIC, 0.1 UF, +-20%, 50 VDC	72982	8121-050-651-104M	16771020-018	2		
6-13		C3	. CAPACITOR,FIXED,CERAMIC DIELECTRIC,1000UUF,+-20%,50VDC	72982	8101-050-651-102M	16771020-003	1		
6-13		C4	. CAPACITOR, FIXED, ELECTROLYTIC, 100UF, +-10%, 15VDC	26769	KNS107E015K	16758058-246	1		
6-13		C5	. CAPACITOR, FIXED, CERAMIC DIELECTRIC, 0.1 UF, +-20%, 50 VDC	72982	8121-050-651-104M	16771020-018	1		
6-13		C6	. CAPACITOR, FIXED, CERAMIC DIELECTRIC, 1UF, +-20%, 50VDC	72982	8131-050-651-105M 5910-498-5856	16771020-025	1		
6-13		C7	. CAPACITOR, FIXED, PLASTIC, DIELECTRIC, 0.0056UF, +-10%,50VDC	06001	75F1R5A562	16770744-215	1		
6-13		C8	. CAPACITOR, FIXED, CERAMIC DIELECTRIC, 0.1 UF, +-20%, 50 VDC	72982	8121-050-651-104M	16771020-018	1		
6-13		C9	. CAPACITOR, FIXED, ELECTROLYTIC, 100UF, +-10%, 15VDC	26769	KNS107E015K	16758058-246	1		
6-13		C10	. CAPACITOR, FIXED, CERAMIC DIELECTRIC, 0.1 UF, +-20%, 50 VDC	72982	8121-050-651-104M	16771020-018	1		
6-13		C11	. CAPACITOR,FIXED,CERAMIC DIELECTRIC,1000UUF,+-20%,50VDC	72982	8101-050-651-102M	16771020-003	1		
6-13		C12	. CAPACITOR, FIXED, CERAMIC DIELECTRIC, 470PF, +-10%, 100VDC	18796	8121-100C0G471K	16771625-107	1		
6-13		R1	. RESISTOR, FIXED, METAL FILM, 14.3K OHMS, +-1%, 1/8W	81349	RNR55K1432FM	16757165-316	1		
6-13		R2	. RESISTOR, FIXED, CARBON COMPOSITION, 62K OHMS, +-5%, 1/4W	81349	RCR07G623JM	16750079-076	1		
6-13		R3	. RESISTOR, FIXED, METAL FILM, 6.81K OHMS, +-1%, 1/8W	81349	RNR55K6811FM	16757165-281	1		
6-13		R4	. RESISTOR, FIXED, CARBON COMPOSITION, 10K OHMS, +-5%, 1/4W	81349	RCR07G103JM	16750079-057	1		
6-13		R5	. RESISTOR, FIXED, WIREWOUND, 0.47 OHM, +-5%, 2W	75042	BWHR47J 5905-962-5466	16756611-200	1		
6-13		R6	. RESISTOR, FIXED, METAL FILM 768 OHMS, +-1%, 1/8W	81349	RNR55K7680FM	16757165-186	1		
6-13		R7	. RESISTOR, FIXED, METAL FILM, 40.2K OHMS, +-1%, 1/8W	81349	RNR55K4022FM	16757165-359	1		
6-13		R8	. RESISTOR, FIXED, CARBON COMPOSITION, 200 OHMS, +-5%, 1/4W	81349	RCR07G201JM	16750079-016	1		
6-13		R9	. RESISTOR, FIXED, METAL FILM, 6.81K OHMS, +-1%, 1/8W	81349	RNR55K6811FM	16757165-281	1		

NOTES

TABLE 6-13. +-12V POWER SUPPLY CIRCUIT CARD ASSEMBLY (SHEET 2 OF 2)

FIGURE NUMBER	INDEX NUMBER	REFERENCE DESIGNATOR	DESCRIPTION 1 2 3 4 5 6 7	MANUFACTURER'S CODE	MANUFACTURER'S PART NUMBER / FEDERAL STOCK NUMBER	HONEYWELL PART NUMBER	QUANTITY PER ASSEMBLY	USABLE ON CODE	NOTES
6-13		R10	. RESISTOR, FIXED, METAL FILM, 14.3K OHMS, +-1%, 1/8W	81349	RNR55K1432FM	16757165-316	1		
6-13		R11	. RESISTOR, FIXED, CARBON COMPOSITION, 10K OHMS, +-5%, 1/4W	81349	RCR07G103JM	16750079-057	1		
6-13		R12	. RESISTOR, FIXED, METAL FILM, 40.2K OHMS, +-1%, 1/8W	81349	RNR55K4022FM	16757165-359	1		
6-13		R13	. RESISTOR, FIXED, METAL FILM 768 OHMS, +-1%, 1/8W	81349	RNR55K7680FM	16757165-186	1		
6-13		R14	. RESISTOR, FIXED, WIREWOUND, 0.47 OHM, +-5%, 2W	75042	BWHR47J 5905-962-5466	16756611-200	1		
6-13		R15	. RESISTOR, FIXED, CARBON COMPOSITION, 2.2K OHMS, +-5%, 1/4W	81349	RCR07G222JM	16750079-041	1		
6-13		R16	. RESISTOR, FIXED, CARBON COMPOSITION, 1K OHMS, +-5%, 1/4W	81349	RCR07G102JM	16750079-033	1		
6-13		R17	. RESISTOR, FIXED, CARBON COMPOSITION, 24K OHMS, +-5%, 1/4W	81349	RCR07G243JM	16750079-066	1		
6-13		R18	. RESISTOR, FIXED, CARBON COMPOSITION, 62K OHMS, +-5%, 1/4W	81349	RCR07G623JM	16750079-076	1		
6-13		R19	. RESISTOR, FIXED, CARBON COMPOSITION, 3.9K OHMS, +-5%, 1/4W	81349	RCR07G392JM	16750079-047	1		
6-13		R20	. RESISTOR,VARIABLE,5K OHMS,+-10%, 3/4W	73138	79PR5K 5905-104-0727	16765947-009	1		
6-13		R21	. RESISTOR,VARIABLE,50K OHMS,+-10%, 3/4W	73138	79PR50K 5905-122-3806	16765947-013	1		
6-13		R22	. RESISTOR,VARIABLE,5K OHMS,+-10%, 3/4W	73138	79PR5K 5905-104-0727	16765947-009	1		
6-13		R23	. RESISTOR,VARIABLE,50K OHMS,+-10%, 3/4W	73138	79PR50K 5905-122-3806	16765947-013	1		
6-13		R24,R25	. RESISTOR, FIXED, CARBON COMPOSITION, 1.8K OHMS, +-5%, 1W	81349	RCR32G182JM	16750077-569	2		
6-13		R26	. RESISTOR, FIXED, CARBON COMPOSITION, 15K OHMS, +-5%, 1/4W	81349	RCR07G153JM	16750079-061	1		
6-13		R27	. RESISTOR, FIXED, CARBON COMPOSITION, 470 OHMS, +-5%, 1/4W	81349	RCR07G471JM	16750079-025	1		
6-13		R28	. RESISTOR, FIXED, CARBON COMPOSITION, 22K OHMS, +-5%, 1/4W	81349	RCR07G223JM	16750079-065	1		
6-13		U1	. INTEGRATED CIRCUIT,VOLTAGE REGULATOR	04713	MC1469R	16770480-014	1		
6-13		U2	. INTEGRATED CIRCUIT,VOLTAGE REGULATOR	04713	MC1463R	16770480-013	1		
6-13		U3,U4	. INTEGRATED CIRCUIT, OPERATIONAL AMPLIFIER (L741-1)	28009		04040505-001	2		
6-13		VR1,VR2	. SEMICONDUCTOR DEVICE, DIODE	04713	1N5234B	16774066-114	2		
6-13		VR3	. SEMICODUCTOR DEVICE, DIODE, ZENER	80131	1N4740A 5961-057-7859	16737938-113	1		
6-13			. PRINTED WIRING BOARD, +-12 POWER SUPPLY	28009		16775530-003	1		

NOTES

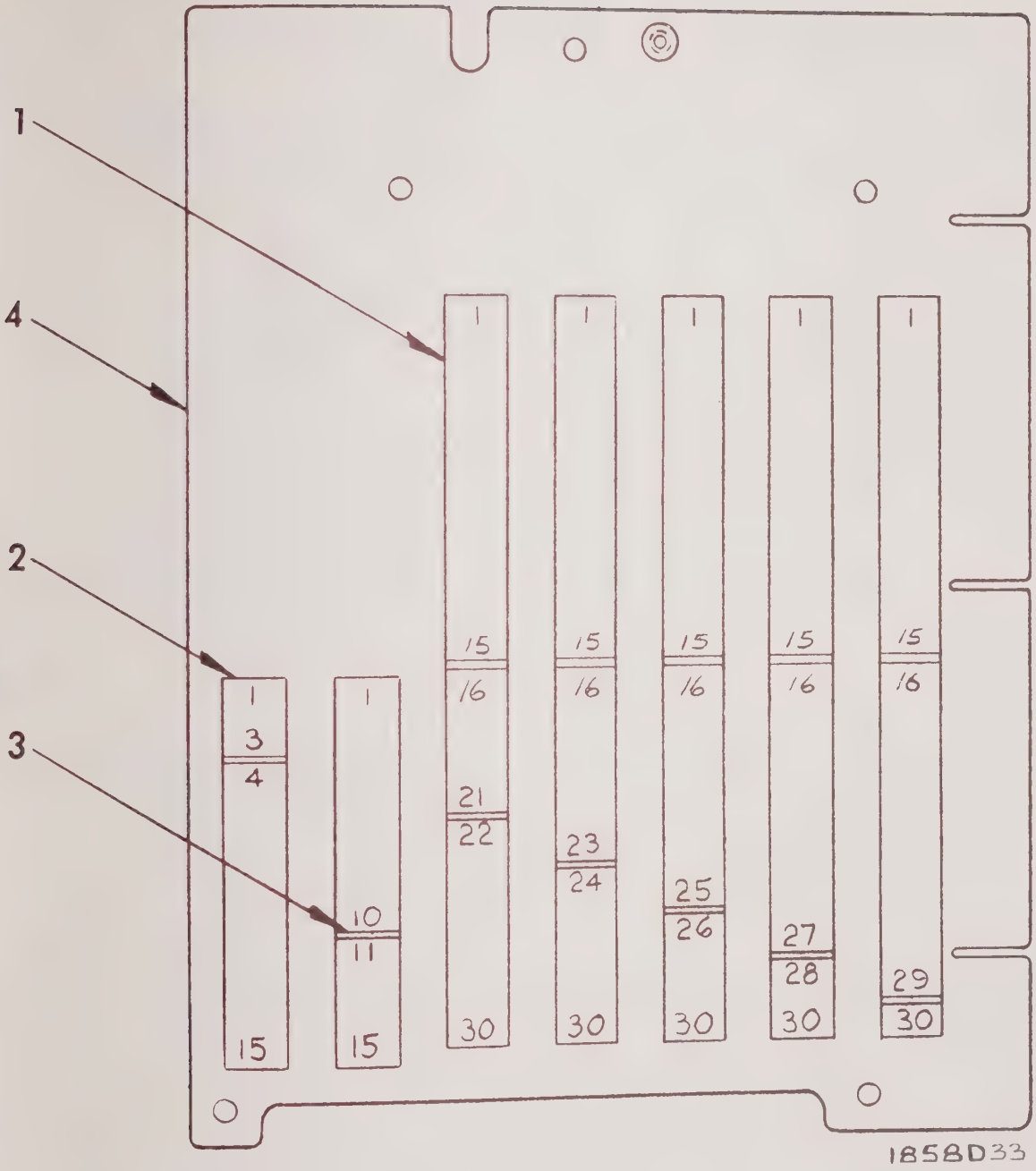


FIGURE 6-14. REAR ELECTRICAL INTERCONNECT CIRCUIT CARD ASSEMBLY

TABLE 6-14. REAR ELECTRICAL INTERCONNECT CIRCUIT CARD ASSEMBLY

FIGURE NUMBER	INDEX NUMBER	REFERENCE DESIGNATOR	DESCRIPTION 1 2 3 4 5 6 7	MANUFACTURER'S CODE	MANUFACTURER'S PART NUMBER / FEDERAL STOCK NUMBER	HONEYWELL PART NUMBER	QUANTITY PER ASSEMBLY	USABLE ON CODE	NOTES
6-14		A3A8	CIRCUIT CARD ASSEMBLY, ELECTRICAL INTERCONNECT, REAR (SEE TABLE 6-4 FOR LOCATION IN NHA)	28009		16776080-002	REF		
6-14	1	XA1-XA5	. CONNECTOR, RECEPTACLE	00779	2-583407-8	16776276-228	5		
6-14	2	XA6,XA7	. CONNECTOR, RECEPTACLE	00779	1-583407-5	16776276-213	2		
6-14	3		. KEY, POLARIZING	00779	583532-1	16776278-001	12		
6-14	4		. PRINTED WIRING BOARD	28009		16775546-001	1		

NOTES:

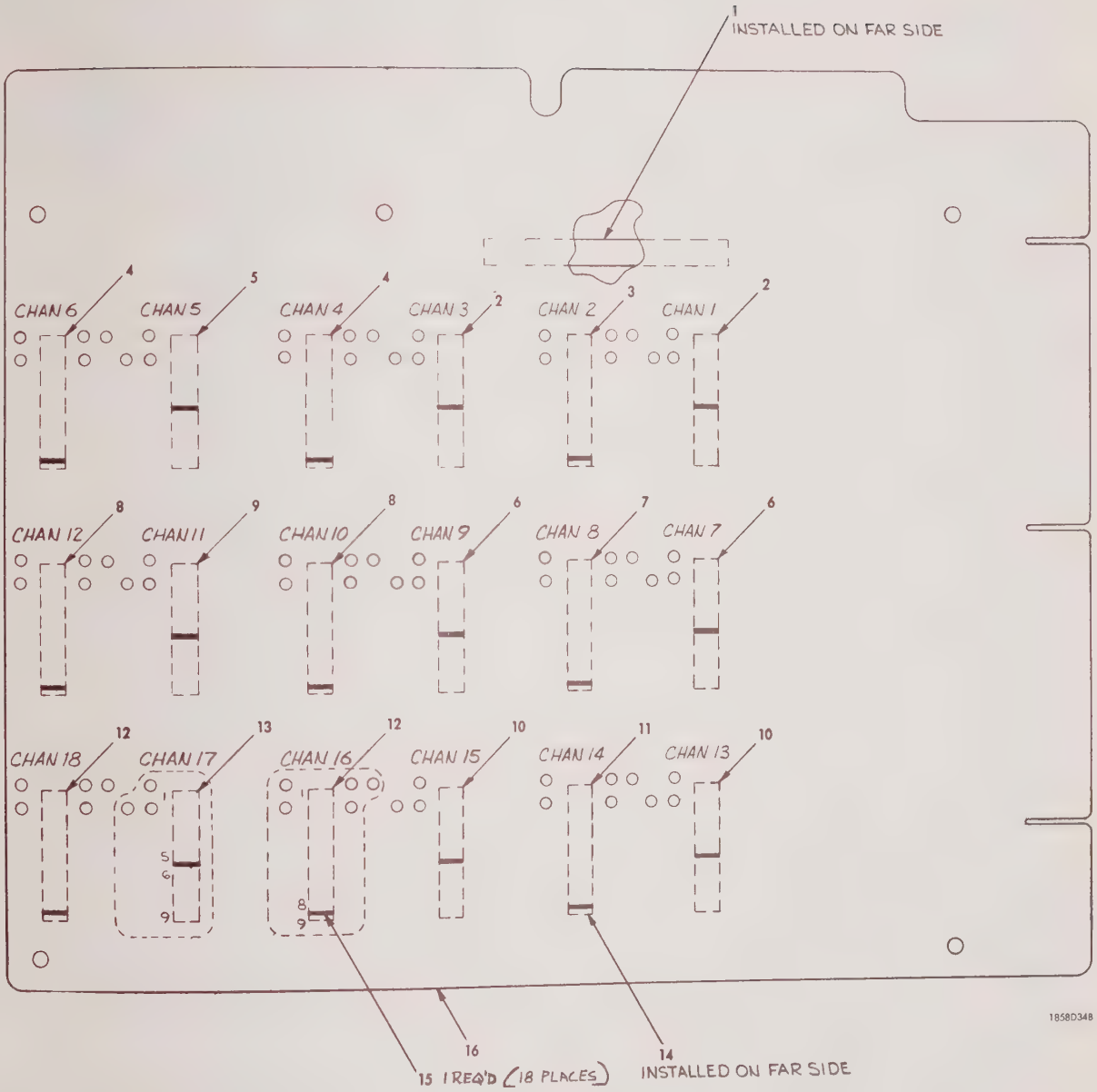


FIGURE 6-15. FRONT ELECTRICAL INTERCONNECT CIRCUIT CARD ASSEMBLY

TABLE 6-15. FRONT ELECTRICAL INTERCONNECT CIRCUIT CARD ASSEMBLY (SHEET 1 OF 2)

FIGURE NUMBER	INDEX NUMBER	REFERENCE DESIGNATOR	DESCRIPTION 1 2 3 4 5 6 7	MANUFACTURER'S CODE	MANUFACTURER'S PART NUMBER / FEDERAL STOCK NUMBER	HONEYWELL PART NUMBER	QUANTITY PER ASSEMBLY	USABLE ON CODE	NOTES
6-15		A3A9	CIRCUIT CARD ASSEMBLY, ELECTRICAL INTERCONNECT, FRONT	28009		16776077-001	REF		
6-15			(SEE TABLE 6-4 FOR LOCATION IN N4A)						
6-15	1	J1	• CONNECTOR, RECEPTACLE	00779	1-583620-2	16776277-212	1		
6-15	2	W1	• CABLE ASSEMBLY, INPUT, CHANNEL 1 AND 3	28009		16776074-001	1		
6-15		J1	• • CONNECTOR, ROUND, MINATURE, FEMALE	02660	165-36 5935-666-4513	16773755-107	1		
6-15	3	W2	• CABLE ASSEMBLY, INPUT, CHANNEL 2	28009		16776074-002	1		
6-15		J1	• • CONNECTOR, ROUND, MINATURE, FEMALE	02660	165-36 5935-666-4513	16773755-107	1		
6-15	2	W3	• CABLE ASSEMBLY, INPUT, CHANNEL 1 AND 3	28009		16776074-001	1		
6-15		J1	• • CONNECTOR, ROUND, MINATURE, FEMALE	02660	165-36 5935-666-4513	16773755-107	1		
6-15	4	W4	• CABLE ASSEMBLY, INPUT, CHANNEL 4 AND 6	28009		16776074-003	1		
6-15		J1	• • CONNECTOR, ROUND, MINATURE, FEMALE	02660	165-36 5935-666-4513	16773755-107	1		
6-15	5	W5	• CABLE ASSEMBLY, INPUT, CHANNEL 5	28009		16776074-004	1		
6-15		J1	• • CONNECTOR, ROUND, MINATURE, FEMALE	02660	165-36 5935-666-4513	16773755-107	1		
6-15	4	W6	• CABLE ASSEMBLY, INPUT, CHANNEL 4 AND 6	28009		16776074-003	1		
6-15		J1	• • CONNECTOR, ROUND, MINATURE, FEMALE	02660	165-36 5935-666-4513	16773755-107	1		
6-15	6	W7	• CABLE ASSEMBLY, INPUT, CHANNEL 7 AND 9	28009		16776074-005	1		
6-15		J1	• • CONNECTOR, ROUND, MINATURE, FEMALE	02660	165-36 5935-666-4513	16773755-107	1		
6-15	7	W8	• CABLE ASSEMBLY, INPUT, CHANNEL 8	28009		16776074-006	1		
6-15		J1	• • CONNECTOR, ROUND, MINATURE, FEMALE	02660	165-36 5935-666-4513	16773755-107	1		
6-15	6	W9	• CABLE ASSEMBLY, INPUT, CHANNEL 7 AND 9	28009		16776074-005	1		
6-15		J1	• • CONNECTOR, ROUND, MINATURE, FEMALE	02660	165-36 5935-666-4513	16773755-107	1		
6-15	8	W10	• CABLE ASSEMBLY, INPUT, CHANNEL 10 AND 12	28009		16776074-007	1		
6-15		J1	• • CONNECTOR, ROUND, MINATURE, FEMALE	02660	165-36 5935-666-4513	16773755-107	1		
6-15	9	W11	• CABLE ASSEMBLY, INPUT, CHANNEL 11	28009		16776074-008	1		
6-15		J1	• • CONNECTOR, ROUND, MINATURE, FEMALE	02660	165-36 5935-666-4513	16773755-107	1		
6-15	8	W12	• CABLE ASSEMBLY, INPUT, CHANNEL 10 AND 12	28009		16776074-007	1		
6-15		J1	• • CONNECTOR, ROUND, MINATURE, FEMALE	02660	165-36 5935-666-4513	16773755-107	1		
6-15	10	W13	• CABLE ASSEMBLY, INPUT, CHANNEL 13 AND 15	28009		16776074-009	1		

NOTES

TABLE 6-15. FRONT ELECTRICAL INTERCONNECT CIRCUIT CARD ASSEMBLY (SHEET 2 OF 2)

FIGURE NUMBER	INDEX NUMBER	REFERENCE DESIGNATOR	DESCRIPTION 1 2 3 4 5 6 7	MANUFACTURER'S CODE	MANUFACTURER'S PART NUMBER / FEDERAL STOCK NUMBER	HONEYWELL PART NUMBER	QUANTITY PER ASSEMBLY	USABLE ON CODE	NOTES
6-15		J1	• • CONNECTOR, ROUND, MINATURE, FEMALE	02660	165-36 5935-666-4513	16773755-107	1		
6-15	11	W14	• CABLE ASSEMBLY, INPUT, CHANNEL 14	28009		16776074-010	1		
6-15		J1	• • CONNECTOR, ROUND, MINATURE, FEMALE	02660	165-36 5935-666-4513	16773755-107	1		
6-15	10	W15	• CABLE ASSEMBLY, INPUT, CHANNEL 13 AND 15	28009		16776074-009	1		
6-15		J1	• • CONNECTOR, ROUND, MINATURE, FEMALE	02660	165-36 5935-666-4513	16773755-107	1		
6-15	12	W16	• CABLE ASSEMBLY, INPUT, CHANNEL 16 AND 18	28009		16776074-011	1		
6-15		J1	• • CONNECTOR, ROUND, MINATURE, FEMALE	02660	165-36 5935-666-4513	16773755-107	1		
6-15	13	W17	• CABLE ASSEMBLY, INPUT, CHANNEL 17	28009		16776074-012	1		
6-15		J1	• • CONNECTOR, ROUND, MINATURE, FEMALE	02660	165-36 5935-666-4513	16773755-107	1		
6-15	17	W18	• CABLE ASSEMBLY, INPUT, CHANNEL 16 AND 18	28009		16776074-011	1		
6-15		J1	• • CONNECTOR, ROUND, MINATURE, FEMALE	02660	165-36 5935-666-4513	16773755-107	1		
6-15	14	XA1-XA18	• CONNECTOR, RECEPTACLE	00779	583533-7	16776276-107	18		
6-15	15		• KEY, POLARIZING	00779	583532-1	16776278-001	18		
6-15	16		• PRINTED WIRING BOARD	28009		16775548-002	1		

NOTES

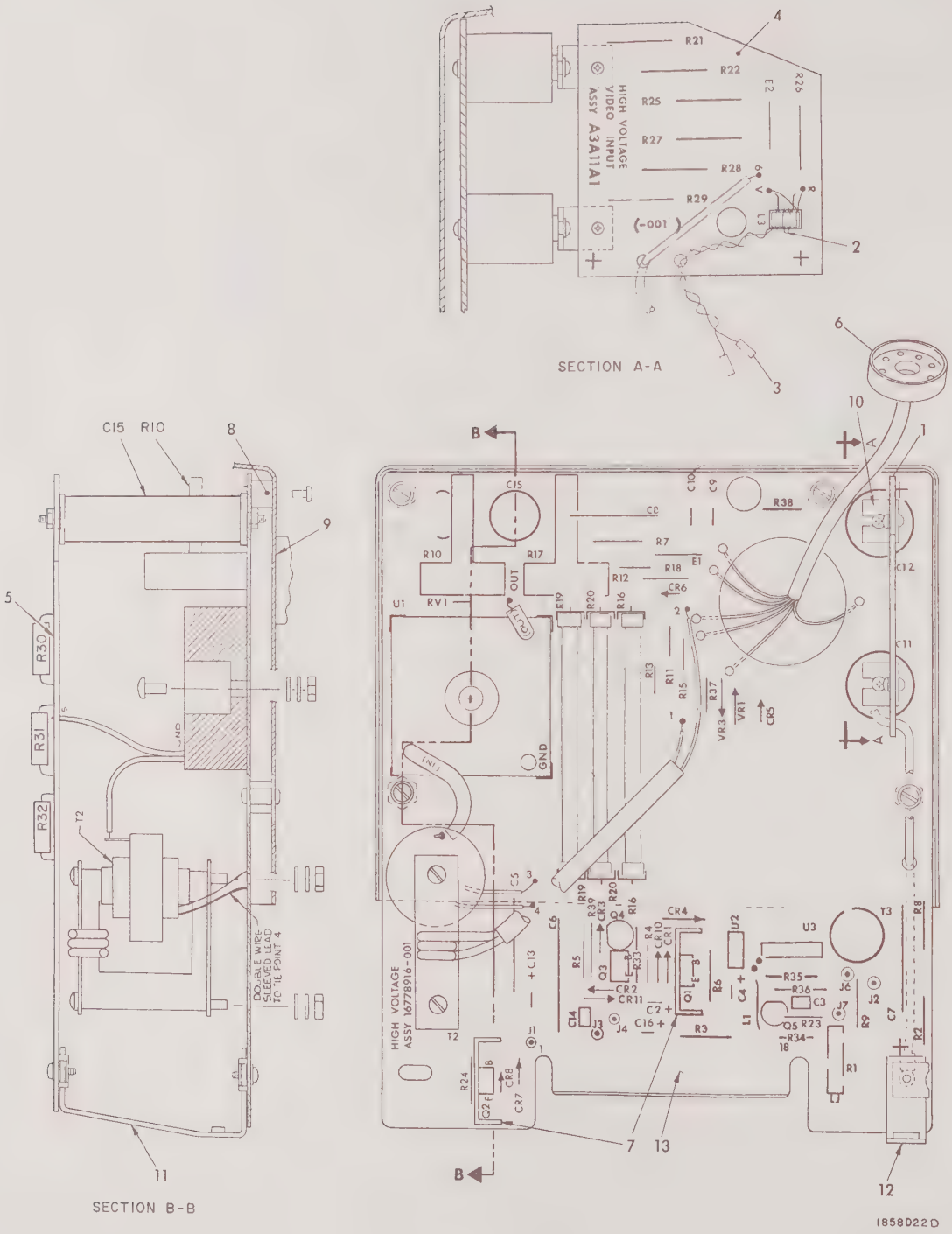


FIGURE 6-16. HIGH VOLTAGE CIRCUIT CARD ASSEMBLY

TABLE 6-16. HIGH VOLTAGE CIRCUIT CARD ASSEMBLY (SHEET 1 OF 4)

FIGURE NUMBER	INDEX NUMBER	REFERENCE DESIGNATOR	DESCRIPTION 1 2 3 4 5 6 7	MANUFACTURER'S CODE	MANUFACTURER'S PART NUMBER / FEDERAL STOCK NUMBER	HONEYWELL PART NUMBER	QUANTITY PER ASSEMBLY	USABLE ON CODE	NOTES
6-16		A3A11	CIRCUIT CARD ASSEMBLY, HIGH VOLTAGE (SEE TABLE 6-4 FOR LOCATION IN NHA)	28009		16778916 001	REF		
6-16	1	A1	. CIRCUIT CARD ASSEMBLY, VIDEO INPUT	28009		16778938-001	1		
6-16		E1	. . NOT USED						
6-16		E2	. . ABSORBER, OVERVOLTAGE	77554	P98	16778184-001	1		
6-16		L1,L2	. . NOT USED						
6-16		L3	. . CORE,TRANSFORMER	78488	57-0981	16778073-001	1		
6-16		R1-R20	. . NOT USED						
6-16		R21,R22	. . RESISTOR, FIXED, CARBON COMPOSITION, 22 OHMS, +-5%, 1W	01121	GB220F	16779497-003	2		
6-16		R23,R24	. . NOT USED						
6-16		R25	. . RESISTOR, FIXED, CARBON COMPOSITION, 22 OHMS, +-5%, 1W	01121	GB220F	16779497-003	1		
6-16		R26	. . RESISTOR, FIXED, CARBON COMPOSITION, 62 OHMS, +-5%, 1W	81349	RCR32G620JM	16750077-534	1		
6-16		R27-R29	. . RESISTOR, FIXED, CARBON COMPOSITION, 22 OHMS, +-5%, 1W	01121	GB220F	16779497-003	3		
6-16	2		. . STRAP,TIEDOWN,ELECTRICAL COMPONENTS	98159	2829-75-1 5330-873-3450	16755973-001	1		
6-16	3		. . TERMINAL,QUICK DISCONNECT	00779	60598-5	16767598-011	1		
6-16	4		. . PRINTED WIRING BOARD	28009		16778178-001	1		
6-16		A2	. CIRCUIT CARD ASSEMBLY, CURRENT LIMITING	28009		16778939-001	1		
6-16		R1-R29	. . NOT USED						
6-16		R30-R32	. . RESISTOR, FIXED, CARBON COMPOSITION, 22 OHMS, +-5%, 1W	01121	GB220F	16779497-003	3		
6-16	5		. . PRINTED WIRING BOARD	28009		16778177-003	1		
6-16		CR1	. SEMICONDUCTOR DEVICE, DIODE	14099	S2F	16776363-001	1		
6-16		CR2,CR3	. SEMICONDUCTOR DEVICE, DIODE	14433	1N4148	16756865-003	2		
6-16		CR4	. SEMICONDUCTOR DEVICE,DIODE	14099	3SM4	16774077-002	1		
6-16		CR5,CR6	. SEMICONDUCTOR DEVICE, DIODE	14433	1N4148	16756865-003	2		
6-16		CR7,CR8	. SEMICONDUCTOR DEVICE, DIODE	14099	S2F	16776363-002	2		
6-16		CR9	. NOT USED						
6-16		CR10	. SEMICONDUCTOR DEVICE,DIODE	14099	3SM4	16774077-002	1		
6-16		C1	. NOT USED						
6-16		C2	. CAPACITOR,FIXED,ELECTROLYTIC,22UF +-20%,25VDC	26769	KNS226C015M	16757885-238	1		
6-16		C3	. CAPACITOR, FIXED, CERAMIC DIELECTRIC, 0.1 UF, +-20%, 50 VDC	72982	8121-050-651-104M	16771020-018	1		
6-16		C4	. CAPACITOR, FIXED, ELECTROLYTIC, 180UF, +-10%, 6VDC	26769	KNS187E006K	16758058-049	1		
6-16		C5	. CAPACITOR, FIXED, PLASTIC DIELECTRIC, 1.0UF, +-10%, 200VDC	04099	H126	16778828-001	1		

NOTES:

TABLE 6-16. HIGH VOLTAGE CIRCUIT CARD ASSEMBLY (SHEET 2 OF 4)

FIGURE NUMBER	INDEX NUMBER	REFERENCE DESIGNATOR	DESCRIPTION 1 2 3 4 5 6 7	MANUFACTURER'S CODE	MANUFACTURER'S PART NUMBER / FEDERAL STOCK NUMBER	HONEYWELL PART NUMBER	QUANTITY PER ASSEMBLY	USABLE ON CODE	NOTES
6-16		C6	. CAPACITOR, FIXED, PLASTIC, DIELECTRIC, 13000UUF, +-5%,500VDC	26625	611-13000JH	16758746-094	1		
6-16		C7	. CAPACITOR, FIXED, PLASTIC, DIELECTRIC, 0.47UF, +-20%, 400VDC	12406	ZD4A474	16774763-333	1		
6-16		C8	. CAPACITOR, FIXED, PLASTIC, DIELECTRIC, 2UF, +-20%, 100VDC	12406	Z1A205	16774763-039	1		
6-16		C9,C10	. CAPACITOR, FIXED, CERAMIC DIELECTRIC, 10000PF, +-20%, 1000 VDC	56289	5GAS10 5910-828-5705	16750036-045	1		
6-16		C11,C12	. CAPACITOR,FIXED,CERAMIC DIELECTRIC,500UUF,+50/-20%,20KVDC	56289	708C50 5910-465-2276	16756410-001	2		
6-16		C13	. CAPACITOR,FIXED,ELECTROLYTIC, 100UF,+-10%,20VDC	17554	C4137	16758058-346	1		
6-16		C14	. CAPACITOR, FIXED, CERAMIC DIELECTRIC, 0.1 UF, +-20%, 50 VDC	72982	8121-050-651-104M	16771020-018	1		
6-16		C15	. CAPACITOR, FIXED,GLASS DIELECTRIC ,0.002UF, +-10%, 15KVDC	99120	0F150-202	16774050-705	1		
6-16		C16	. CAPACITOR,FIXED,ELECTROLYTIC, 100UF,+-10%,20VDC	17554	C4137	16758058-346	1		
6-16		C17	. CAPACITOR,FIXED,ELECTROLYTIC, 250UF,+50/-10%,64VDC	73445	C437ARH250 5910-994-6910	16758518-364	1		
6-16		E1	. ABSORBER, OVERVOLTAGE	77554	P98	16778184-001	1		
6-16		J1-J4	. TERMINAL,QUICK DISCONNECT	00779	60599-3	16767598-001	4		
6-16		J5	. NOT USED						
6-16		J6,J7	. TERMINAL,QUICK DISCONNECT	00779	60599-3	16767598-001	2		
6-16		L1	. COIL,RADIO FREQUENCY	02114	VK200-10-3B 5950-832-4881	16773775-003	1		
6-16		Q1	. TRANSISTOR	04713	2N4921 5961-411-1310	16766748-004	1		
6-16		Q2	. TRANSISTOR	04713	2N4920 5961-177-3577	16766748-003	1		
6-16		Q3	. TRANSISTOR	04713	2N4918 5961-410-8882	16766748-001	1		
6-16		Q4	. TRANSISTOR	04713	2N3906 5961-072-0128	16762173-002	1		
6-16		Q5	. TRANSISTOR	04713	MPSA05-5	16778668-001	1		
6-16		R1	. RESISTOR,VARIABLE,50K OHMS,+-10%, 3/4W	73138	79PR50K 5905-122-3806	16765947-013	1		
6-16		R2	. RESISTOR, FIXED, METAL FILM, 46.4K OHMS, +-1%, 1/8W	81349	RN55C4642F 5905-900-9156	16757165-365	1		
6-16		R3	. RESISTOR,FIXED,CARBON COMPOSITION 2K OHMS,+-5%,1/2W	81349	RC20GF202J 5905-190-8887	16750076-557	1		
6-16		R4	. RESISTOR, FIXED, CARBON COMPOSITION, 620 OHMS, +-5%, 1/4W	81349	RC07GF621J 5905-801-6998	16750079-028	1		
6-16		R5	. RESISTOR, FIXED, METAL FILM, 100 OHMS, +-1%, 1/8 W	81349	RN55C1000F 5905-982-0477	16757165-101	1		
6-16		R6	. RESISTOR, FIXED, CARBON COMPOSITION, 39 OHMS, +-5%, 1/2W	81349	RC20GF390J 5905-195-5546	16750076-515	1		
6-16		R7	. RESISTOR, FIXED, CARBON COMPOSITION 200 OHMS, +-5%, 1/2W	81349	RC20GF201J	16750076-532	1		
6-16		R8	. RESISTOR, FIXED, CARBON COMPOSITION, 470K OHMS,+-5%, 1/2W	81349	RC20GF474J 5905-279-2515	16750076-614	1		

NOTES

TABLE 6-16. HIGH VOLTAGE CIRCUIT CARD ASSEMBLY (SHEET 3 OF 4)

FIGURE NUMBER	INDEX NUMBER	REFERENCE DESIGNATOR	DESCRIPTION 1 2 3 4 5 6 7	MANUFACTURER'S CODE	MANUFACTURER'S PART NUMBER / FEDERAL STOCK NUMBER	HONEYWELL PART NUMBER	QUANTITY PER ASSEMBLY	USABLE ON CODE	NOTES
6-16		R9	• RESISTOR, FIXED, WIREWOUND, 0.51 OHMS, +-1%, 1 W	81349	RW70UR511F 5905-442-1137	16775831-418	1		
6-16		R10	• RESISTOR, VARIABLE, 500K OHMS, +-30%, 1/4W	11237	YLM-45-500K	16775731-014	1		
6-16		R11	• RESISTOR,FIXED,CARBON COMPOSITION 150K OHMS,+-5%,1/4W	81349	RC07GF154J 5905-686-9995	16750079-085	1		
6-16		R12	• RESISTOR, FIXED, CARBON COMPOSITION, 7.5MEG OHMS, +-5% 1/2W	81349	RC20GF755J 5905-279-2508	16750076-643	1		
6-16		R13	• RESISTOR, FIXED, CARBON COMPOSITION, 3 MEG OHMS, +-5%, 1/4W	81349	RC07GF305J 5905-835-2403	16750079-116	1		
6-16		R14	• NOT USED						
6-16		R15	• RESISTOR,FIXED,CARBON COMPOSITION 100K OHMS,+-5%,1/4W	81349	RC07GF104J 5905-686-3129	16750079-081	1		
6-16		R16	• RESISTOR, FIXED, FILM	11502	CGH5-100MEG-PORM10PCT	16778256-001	1		
6-16		R17	• RESISTOR, VARIABLE, 7.5MEG OHMS, +-30%, 1/4W	11237	YLM-45-7R5MEG	16775731-019	1		
6-16		R18	• RESISTOR,FIXED,CARBON COMPOSITION 2.7MEGOHMS,+-5%,1/4W	81349	RC07GF275J 5905-810-2779	16750079-115	1		
6-16		R19,R20	• RESISTOR, FIXED, METAL FILM, 160MEG OHMS, +-5%, 3W	11502	MVX3-160MEG5PCT	16770052-009	2		
6-16		R21,R22	• NOT USED						
6-16		R23	• RESISTOR, FIXED, CARBON COMPOSITION, 620 OHMS, +-5%, 1/4W	81349	RC07GF621J 5905-801-6998	16750079-028	1		
6-16		R24	• RESISTOR, FIXED, WIREWOUND, 62 OHMS, +-5%, 2W	91367	PS2C620J	16775759-068	1		
6-16		R25-R32	• NOT USED						
6-16		R33	• RESISTOR, FIXED, CARBON COMPOSITION, 4.7 OHMS, +-5%, 1W	81349	RC32GF4R7J 5905-101-7586	16750077-507	1		
6-16		R34	• RESISTOR, FIXED,CARBON COMPOSITION, 3K OHMS, +/-5%, 1/4W	81349	RC07GF302J 5905-682-4097	16750079-044	1		
6-16		R35,R36	• RESISTOR, FIXED, METAL FILM, 121K OHMS, +-1%, 1/8W	07716	CCMT0-1213F	16757165-409	2		
6-16		R37	• RESISTOR, FIXED, CARBON COMPOSITION, 10 MEG OHMS, +-5%, 1/4W	81349	RC07G106J 5905-803-3468	16750079-129	1		
6-16		R38	• RESISTOR, FIXED, CARBON COMPOSITION, 9.1 MEG OHMS, +-5%, 1/2 W 1/2W	81349	RC20GF915J 5905-279-2507	16750076-645	1		
6-16		R39	• RESISTOR, FIXED, METAL FILM, 100 OHMS, +-1%, 1/8 W	81349	RN55C1000F 5905-982-0477	16757165-101	1		
6-16		RV1	• RESISTOR, VOLTAGE SENSITIVE	09214	V130LA10	16778886-001	1		
6-16		T1	• NOT USED						
6-16		T2	• TRANSFORMER, POWER	28009		16776174-002	1		
6-16		T3	• TRANSFORMER, CURRENT	28009		16776194-001	1		
6-16		U1	• SEMICONDUCTOR DEVICE, DIODE	27777	MH911H02	16776365-001	1		
6-16		U2	• INTEGRATED CIRCUIT, BUFFER	01295	SN75451P 5962-497-1587	16775733-001	1		
6-16		U3	• INTEGRATED CIRCUIT, OPERATIONAL AMPLIFIER	04713	L741-1	04040505-001	1		

NOTES:

TABLE 6-16. HIGH VOLTAGE CIRCUIT CARD ASSEMBLY (SHEET 4 OF 4)

FIGURE NUMBER	INDEX NUMBER	REFERENCE DESIGNATOR	DESCRIPTION 1 2 3 4 5 6 7	MANUFACTURER'S CODE	MANUFACTURER'S PART NUMBER / FEDERAL STOCK NUMBER	HONEYWELL PART NUMBER	QUANTITY PER ASSEMBLY	USABLE ON CODE	NOTES
6-16		VR1	. SEMICONDUCTOR DEVICE, DIODE	04713	1N5256A	16774066-036	1		
6-16		VR2	. NOT USED						
6-16		VR3	. SEMICONDUCTOR DEVICE, DIODE	04713	1N5257B	16774066-137	1		
6-16		VR4	. SEMICONDUCTOR DEVICE, DIODE	04713	1N5235B 5961-103-1583	16774066-115	1		
6-16	6	XV1	. SOCKET ASSEMBLY, ELECTRON TUBE	01009	212MINC	16773901-002	1		
6-16	7		. HEAT SINK, TRANSISTOR	98978	PA2-1CB 5961-469-7449	16774665-003	2		
6-16	8		. POST, ELECTRICAL/MECHANICAL, NYLON, 1/4 IN, HEX, 6-32 BY 1/4 IN, LG	06540	8211N0632	16762945-316	4		
6-16	9		. COVER, PROTECTIVE	28009		16775883-001	1		
6-16	10		. BRACKET, MOUNTING	28009		16778176-001	2		
6-16	11		. BRACKET, MOUNTING	28009		16778175-001	1		
6-16	12		. BRACKET, ANGLE	28009		16775903-001	1		
6-16	13		. PRINTED WIRING BOARD	28009		16778915-002	1		

NOTES

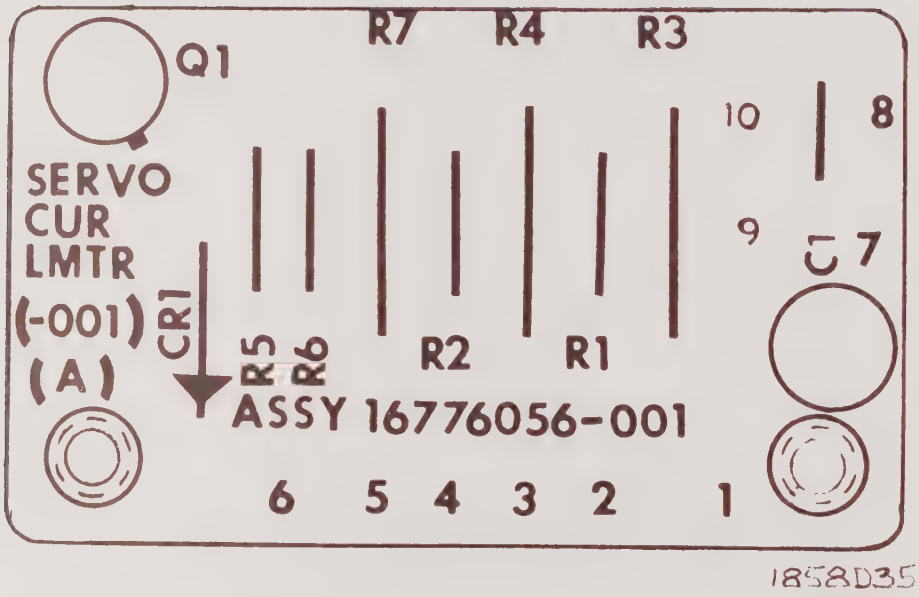


FIGURE 6-17. SERVO CURRENT LIMITER CIRCUIT CARD ASSEMBLY

TABLE 6-17. SERVO CURRENT LIMITER CIRCUIT CARD ASSEMBLY

FIGURE NUMBER	INDEX NUMBER	REFERENCE DESIGNATOR	DESCRIPTION 1 2 3 4 5 6 7	MANUFACTURER'S CODE	MANUFACTURER'S PART NUMBER / FEDERAL STOCK NUMBER	HONEYWELL PART NUMBER	QUANTITY PER ASSEMBLY	USABLE ON CODE	NOTES
6-17		A4A1	CIRCUIT CARD ASSEMBLY, SERVO CURRENT LIMITER (SEE TABLE 6-5 FOR LOCATION IN NHA)	28009		16776056-001	REF		
6-17		CR1	. SEMICONDUCTOR DEVICE, DIODE	04713	1N4002 5961-880-4783	16756961-002	1		
6-17		C1	. CAPACITOR,FIXED,CERAMIC DIELECTRIC,0.1UF,+-20%,50VDC	56289	C023B500L104M	16757455-008	1		
6-17		Q1	. TRANSISTOR	80131	2N3053 5961-985-9073	16763169-001	1		
6-17		R1,R2	. RESISTOR, FIXED, CARBON COMPOSITION, 100 OHMS, +-5%, 1/4W	81349	RCR07G101JM	16750079-009	2		
6-17		R3,R4	. RESISTOR, FIXED, WIREWOUND, 0.2 OHMS, +-1%, 3W	91637	RWP20-0R2	16761545-012	2		
6-17		R5,R6	. RESISTOR, FIXED, CARBON COMPOSITION, 100 OHMS, +-5%, 1/4W	81349	RCR07G101JM	16750079-009	2		
6-17		R7	. RESISTOR, FIXED, WIREWOUND, 0.2 OHMS, +-1%, 3W	91637	RWP20-0R2	16761545-012	1		
6-17			. PRINTED WIRING BOARD	28009		16776019-002	1		

NOTES:

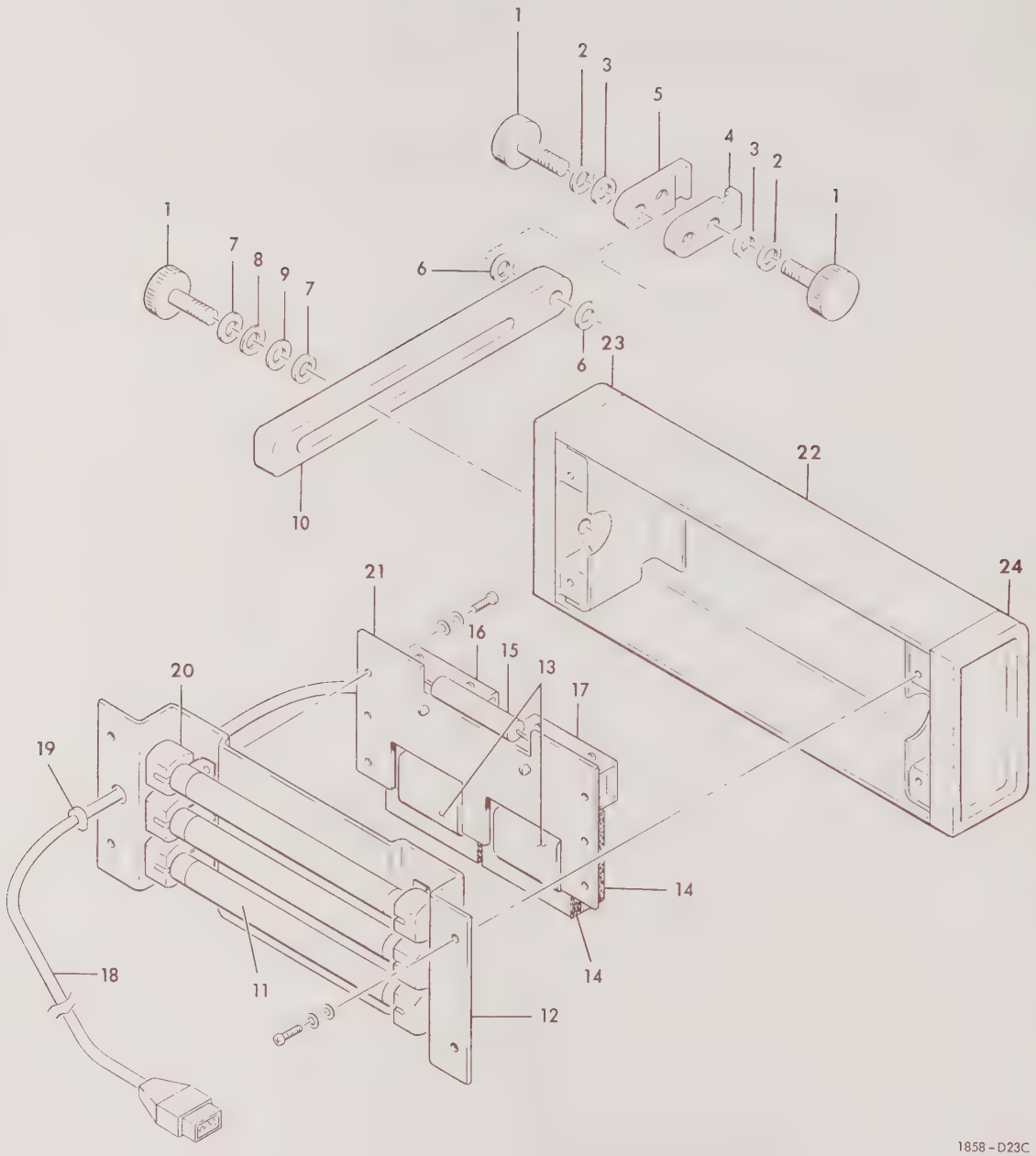


FIGURE 6-18. LATENSIFTER ASSEMBLY

TABLE 6-18. LATENSIFIER ASSEMBLY

FIGURE NUMBER	INDEX NUMBER	REFERENCE DESIGNATOR	DESCRIPTION 1 2 3 4 5 6 7	MANUFACTURER'S CODE	MANUFACTURER'S PART NUMBER / FEDERAL STOCK NUMBER	HONEYWELL PART NUMBER	QUANTITY PER ASSEMBLY	USABLE ON CODE	NOTES
6-18			LATENSIFIER ASSEMBLY	28009		16775753-004	REF		
6-18	1		. LOCKING SCREW	28009		16307505-002	3		
6-18	2		. WASHER, FLAT 1/4 IN. ID	28009	COML	16775674-014	2		
6-18	3		. WASHER, NYLON, 0.253 IN. ID BY 0.500 IN. OD BY 0.031 IN. THK	06540	2260N253	16737979-044	2		
6-18	4		. MOUNTING BLOCK, OUTSIDE	28009		16774844-001	1		
6-18	5		. MOUNTING BLOCK, INSIDE	28009		16774844-002	1		
6-18	6		. WASHER, FLAT, SPECIAL	28009		16778034-001	2		
6-18	7		. WASHER, FLAT, NYLON	28009	COML	16302128-001	2		
6-18	8		. WASHER, SPRING TENSION	28009	COML	16105453-001	1		
6-18	9		. WASHER,FLAT,SST,0.250 IN. ID BY 0.500 IN. OD BY 0.010 IN. THK	28009	COML	16105115-001	1		
6-18	10		. ADJUSTING ARM	28009		16307507-002	1		
6-18	11	DS1-DS3	. LAMP,FLUORESCENT	08806	F4T5CW 6240-295-2652	16200115-001	3		
6-18	12		. NOT USED						
6-18	13	L1,L2	. BALLAST, LAMP	90640	780-001	16776164-001	2		
6-18	14		. MOUNT, RESILIENT	90640	A114SHT	16778918-001	4		
6-18	15	R1	. RESISTOR, FIXED, WIREWOUND, 300 OHMS, +-10%, 10W	11502	PW10-300	16762608-059	1		
6-18	16	S1	. SWITCH, PUSH BUTTON	16592	1055-15 5930-781-3385	16100742-003	1		
6-18	17	S2	. SWITCH, PUSH BUTTON	16592	1055-25 5930-072-1820	16100742-004	1		
6-18	18	W1	. CABLE ASSEMBLY	28009		16780335-001	1		
6-18	19		. BUSHING, STRAIN RELIEF, CABLE	28520	SR6W1 5975-061-7035	16750479-013	1		
6-18	20	XDS1-3	. LAMPHOLDER	08805	ALF141-33 6250-179-2155	16100154-001	6		
6-18	21		. PLATE, COMPONENT MOUNTING	28009		16776142-002	1		
6-18	22		. COVER ASSEMBLY	28009		16776145-001	1		
6-18	23		. END PLATE ASSEMBLY	28009		16776156-001	1		
6-18	24		. END PLATE	28009		16766262-002	1		

NOTES:

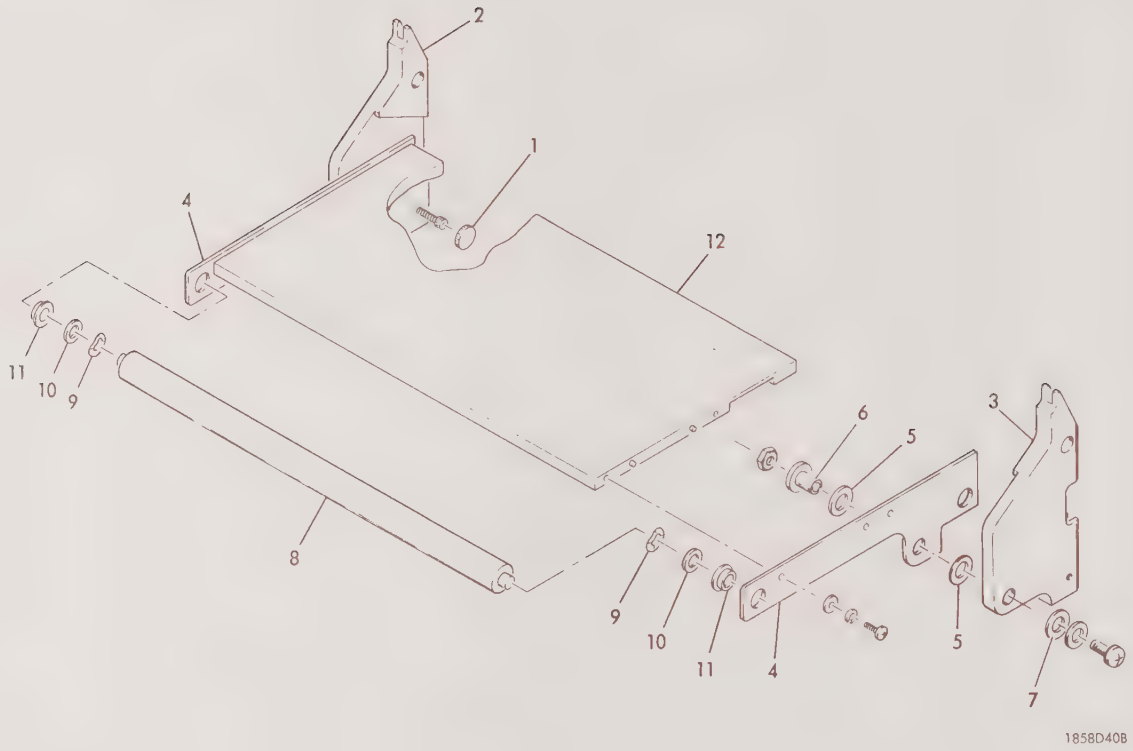


FIGURE 6 - 19. REFERENCE PLATEN ASSEMBLY

TABLE 6-19. REFERENCE PLATEN ASSEMBLY

FIGURE NUMBER	INDEX NUMBER	REFERENCE DESIGNATOR	DESCRIPTION 1 2 3 4 5 6 7	MANUFACTURER'S CODE	MANUFACTURER'S PART NUMBER / FEDERAL STOCK NUMBER	HONEYWELL PART NUMBER	QUANTITY PER ASSEMBLY	USABLE ON CODE	NOTES
6-19			PLATEN ASSEMBLY, REFERENCE	28009		16778736-003	REF		
6-19	1		. CAP, THUMBSCREW, PLASTIC	28009		16779010-202	3		
6-19	2		. HANGER REFERENCE PLATEN, LEFT HAND	28009		16783654-002	1		
6-19	3		. HANGER REFERENCE PLATEN, RIGHT HAND	28009		16783654-003	1		
6-19	4		. END PLATE, PLATEN	28009		16783655-001	2		
6-19	5		. SHIM	28009		16776229-001	4		
6-19	6		. POVIT, REFERENCE PLATEN	28009		16783656-001	2		
6-19	7		. WASHER, NYLON, 0.171 IN. ID BY 0.437 IN. OD BY 0.031 IN. THK	06540	2259N171	16737979-014	2		
6-19	8		. ROLLER, FRONT TURN AROUND	28009		16775469-001	2		
6-19	9		. SPRING, FLAT, CAM LOADING	28009		16775454-001	4		
6-19	10		. WASHER, FLAT, CRES, 0.312 IN. OD BY 0.254 IN. ID BY 0.010 IN. THK	28009		16775467-001	4		
6-19	11		. BEARING, BALL, ANNULAR, FLANGED	23589	R1F614ZZ	16738273-133	4		
6-19	12		. PLATE, WRITING	28009		16776222-001	1		

NOTES:

TABLE 6-20. RACK MOUNTING MODIFICATION KIT

FIGURE NUMBER	INDEX NUMBER	REFERENCE DESIGNATOR	DESCRIPTION 1 2 3 4 5 6 7	MANUFACTURER'S CODE	MANUFACTURER'S PART NUMBER / FEDERAL STOCK NUMBER	HONEYWELL PART NUMBER	QUANTITY PER ASSEMBLY	USABLE ON CODE	NOTES
			KIT, RACK MOUNTING, UNITS WITH SLIDE MOUNTING COVER	28009		16776101-002	1	A	
			KIT, RACK MOUNTING, UNITS WITHOUT SLIDE MOUNTING COVER	28009		16776101-003	1	B	
			. ANGLE, RACK STOP	28009		16778554-001	2		
			. COVER, SIDE, SLIDE MOUNTING	28009		16775925-002	2	B	
			. SLIDE, CHASSIS	06666	C230S18	16766903-004	1		

NOTES

TABLE 6-21. SERVICE KIT

FIGURE NUMBER	INDEX NUMBER	REFERENCE DESIGNATOR	DESCRIPTION 1 2 3 4 5 6 7	MANUFACTURER'S CODE	MANUFACTURER'S PART NUMBER / FEDERAL STOCK NUMBER	HONEYWELL PART NUMBER	QUANTITY PER ASSEMBLY	USABLE ON CODE	NOTES
			SERVICE KIT, 1858 VISICORDER	28009		16776102-002	1		
			. CIRCUIT CARD ASSEMBLY, EXTENDER, POWER SUPPLY	28009		16776292-001	1		
			. CIRCUIT CARD ASSEMBLY, EXTENDER, 30/60 POSITION	28009		16776293-001	1		
			. CIRCUIT CARD ASSEMBLY, MODULE EXTENDER	28009		16778318-001	1		
			. TOOL, ALIGNMENT	72653	8276 5120-288-7781	16764891-001	1		
			. FUSE,CARTRIDGE, 1.5 AMP, 250V	71400	MDX1-5 5920-990-3116	16750231-031	5		
			. FUSE,CARTRIDGE, 0.125 AMP, 250V, SLO BLO	71400	MDL-125	16750231-025	5		
			. FUSE,CARTRIDGE, 0.75 AMP, 250V	71400	MDL-750	16750231-029	5		

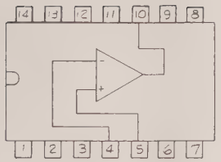
NOTES:

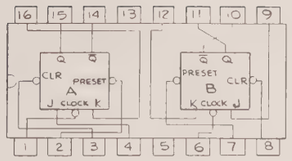
SECTION 7

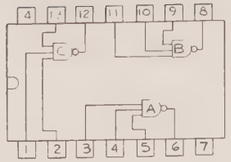
SCHEMATICS

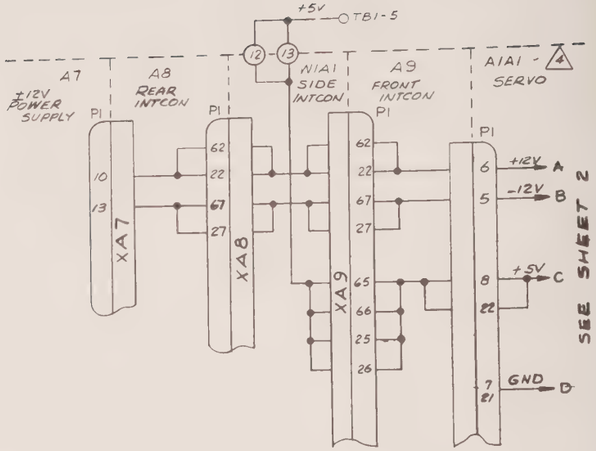
NOTES:

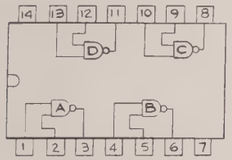
1. UNLESS OTHERWISE SPECIFIED:
   RESISTANCE VALUES ARE IN OHMS, ±1%, ¼ W.
   CAPACITANCE VALUES ARE IN U F, ±10%, 50V.
   DIODES ARE IN4148.
2. REFERENCE DESIGNATIONS ARE SHOWN FOR REFERENCE ONLY AND DO NOT APPEAR ON PART.
3. ONLY PARTIAL REFERENCE DESIGNATIONS ARE SHOWN. FOR COMPLETE DESIGNATION, PREFIX WITH A3.
4. INDICATED DESIGNATIONS ARE COMPLETE.
5. ▭ DENOTES PANEL NOMENCLATURE

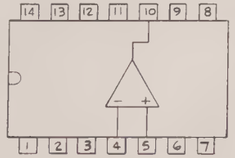


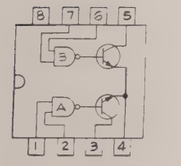


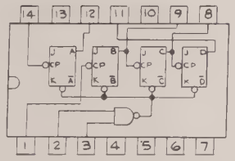












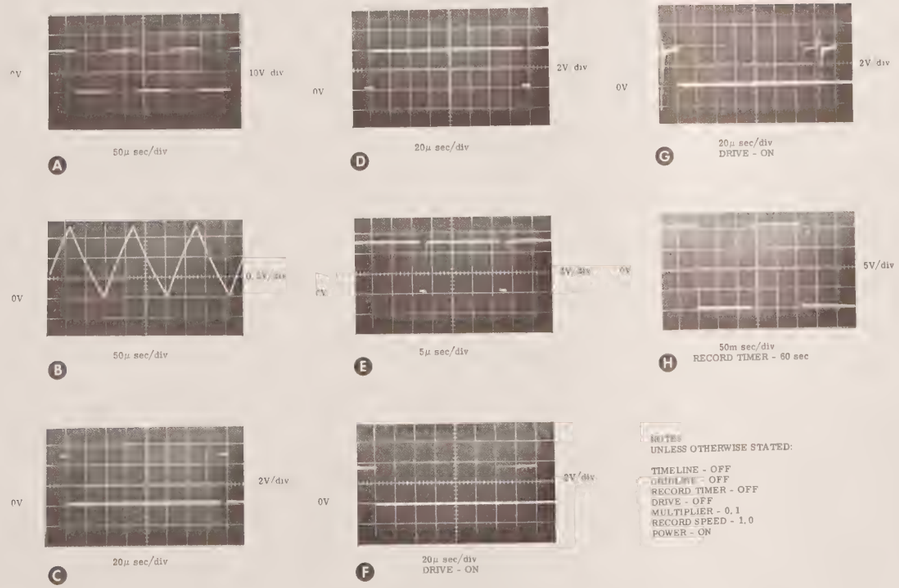
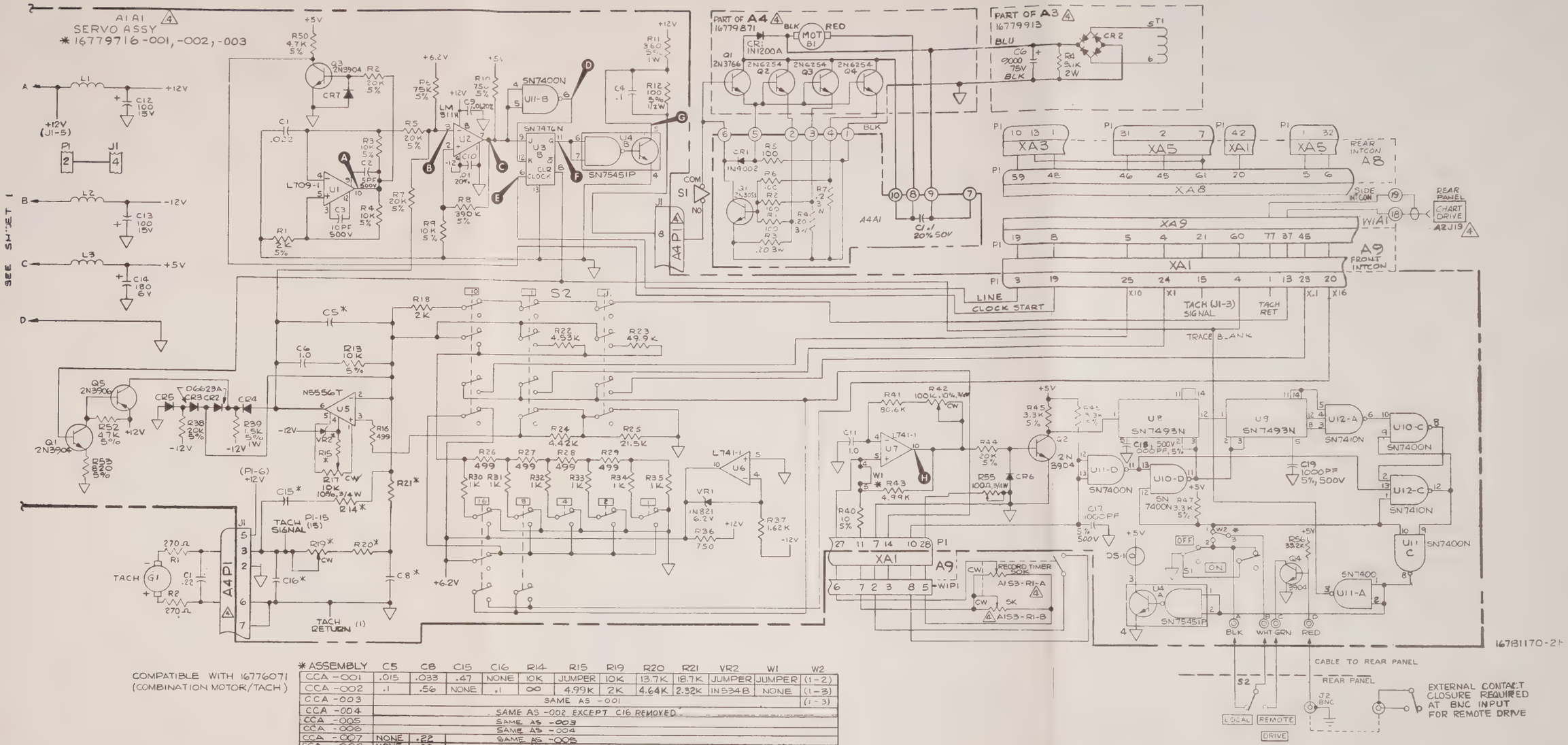


Figure 7-1. Servo Schematic
(Sheet 1 of 2)



COMPATIBLE WITH 16776071 (COMBINATION MOTOR/TACH)

*ASSEMBLY	C5	C8	C15	C16	R14	R15	R19	R20	R21	VR2	W1	W2
CCA -001	.015	.033	.47	NONE	10K	JUMPER	10K	13.7K	18.7K	JUMPER	JUMPER	(1-2)
CCA -002	.1	.56	NONE	.1	∞	4.99K	2K	4.64K	2.32K	IN534B	NONE	(1-3)
CCA -003	SAME AS -001											(1-3)
CCA -004	SAME AS -002 EXCEPT C16 REMOVED											
CCA -005	SAME AS -003											
CCA -006	SAME AS -004											
CCA -007	NONE	.22	SAME AS -005									
CCA -008	NONE	.22	SAME AS -006									

REF 16781170 (F)
Figure 7-1. Servo Schematic (Sheet 2 of 2)

NOTES:

1. UNLESS OTHERWISE SPECIFIED
   RESISTANCE VALUES ARE IN OHMS, ±5%, 1/4W.
   CAPACITANCE VALUES ARE IN UF, ±5%, 50 V.
   TRANSISTORS ARE 2N3904.
   DIODES ARE IN4148.

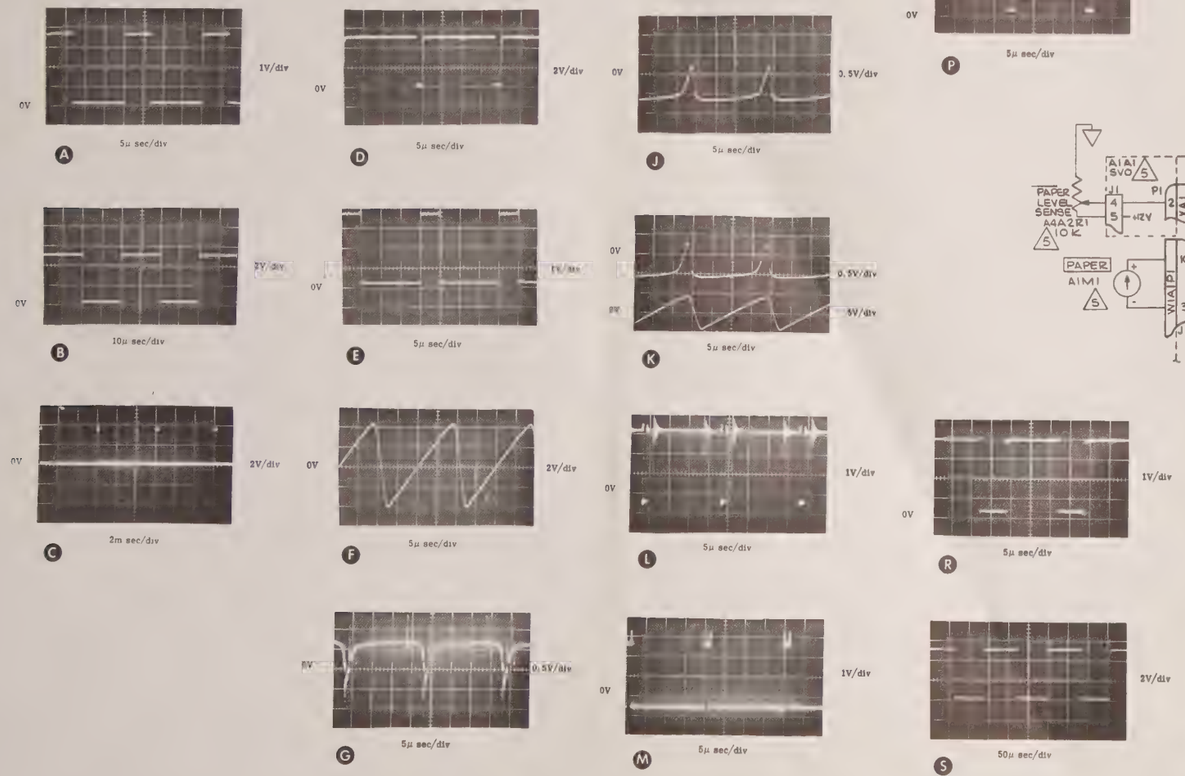
2. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN; FOR COMPLETE DESIGNATION PREFIX WITH A3.

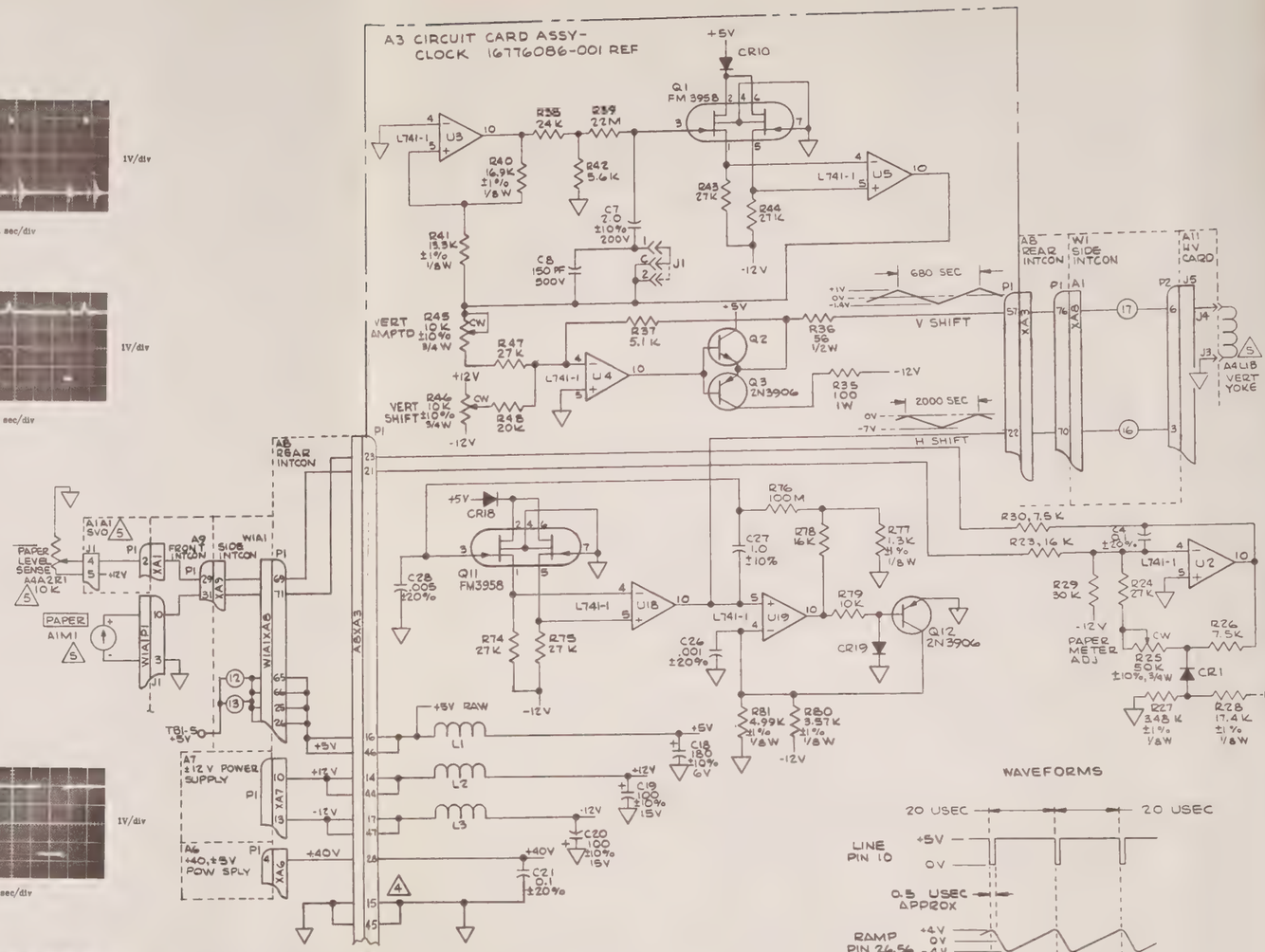
3. INTEGRATED CIRCUIT TYPES ARE AS FOLLOWS:

REF DES	U1, U9	U2, U3, U4, 5 U8, U18, U19	U6, U7	U10, U12	U13	U14	U15, 16 UA710 U17
TYPE	LM301A	L741-1	SN74121	SN7476	SN7400	SN7410	UA9601

4. CIRCUIT CARD PIN NO. 4-9, 18, 19, 24, 25, 27, 29, 30, 34-39, 48, 49, 54, 55, 59, 60 ARE CONNECTED TO GROUND BUT ARE NOT SHOWN ON DIAGRAM.

5. INDICATED REFERENCE DESIGNATIONS ARE COMPLETE.

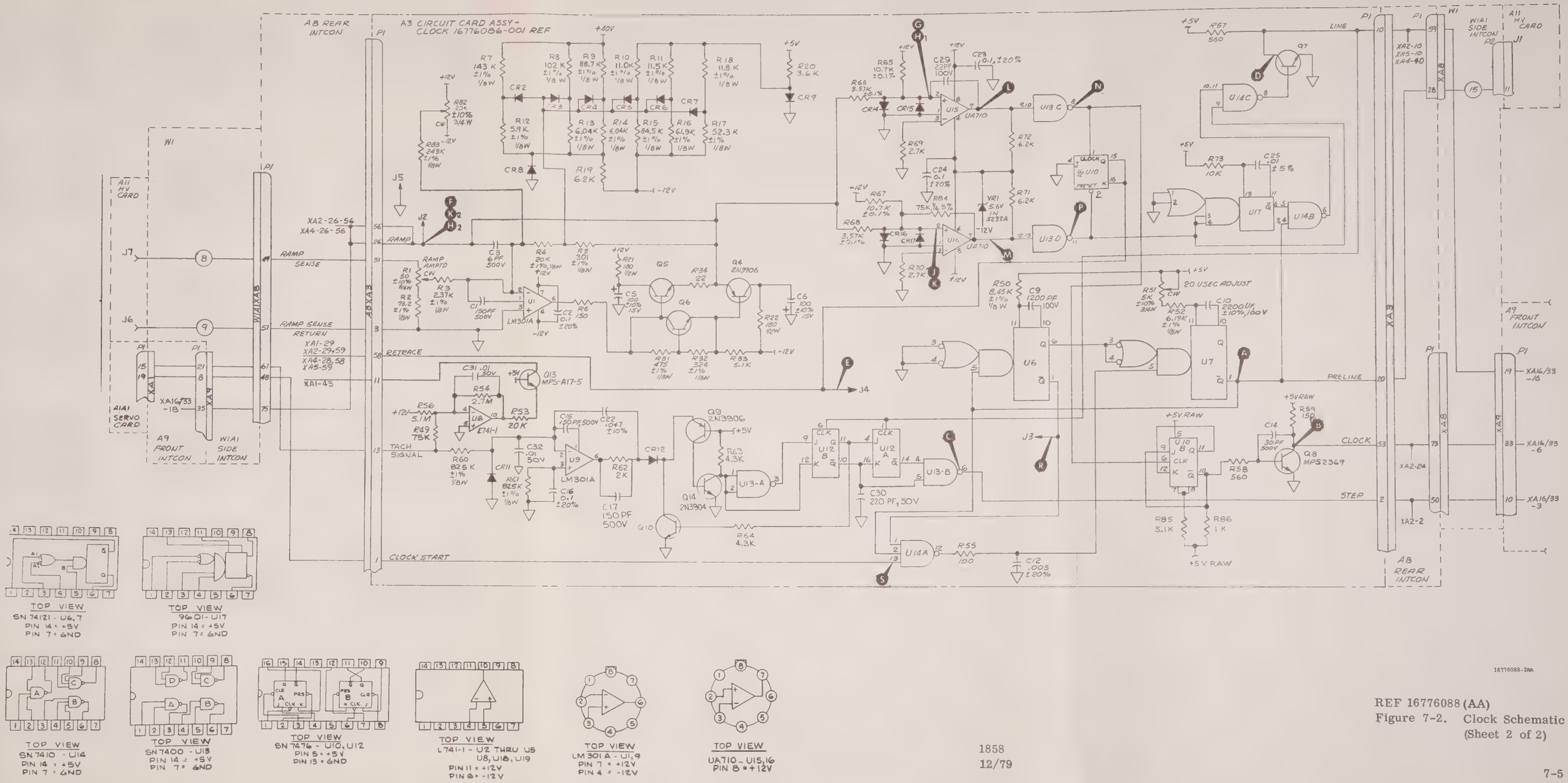

A 1V/div 5μ sec/div
B 2V/div 10μ sec/div
C 2V/div 2m sec/div
D 2V/div 5μ sec/div
E 2V/div 5μ sec/div
F 2V/div 5μ sec/div
G 0.5V/div 5μ sec/div
H 0.5V/div 5V/div 5μ sec/div
J 0.5V/div 5μ sec/div
K 0.5V/div 5V/div 5μ sec/div
L 1V/div 5μ sec/div
M 1V/div 5μ sec/div
N 1V/div 5μ sec/div
P 1V/div 5μ sec/div
R 1V/div 5μ sec/div
S 2V/div 50μ sec/div



NOTES
UNLESS OTHERWISE STATED:

TIMELINE - OFF
GRIDLINE - OFF
RECORD TIMER - OFF
DRIVE - OFF
MULTIPLIER - 0.1
RECORD SPEED - 1.0
POWER - ON

Figure 7-2. Clock Schematic (Sheet 1 of 2)



TOP VIEW
SN 74121 - U6, 7
PIN 14 = +5V
PIN 7 = GND

TOP VIEW
9601 - U17
PIN 14 = +5V
PIN 7 = GND

TOP VIEW
SN 7410 - U14
PIN 14 = +5V
PIN 7 = GND

TOP VIEW
SN 7400 - U13
PIN 14 = +5V
PIN 7 = GND

TOP VIEW
SN 7476 - U10, U12
PIN 5 = +5V
PIN 13 = GND

TOP VIEW
L741-1 - U2 THRU U5 U8, U18, U19
PIN 11 = +12V
PIN 6 = -12V

TOP VIEW
LM 301 A - U1, 9
PIN 7 = +12V
PIN 4 = -12V

TOP VIEW
UA710 - U15, 16
PIN 8 = +12V

16776088-2AA

REF 16776088 (AA)
Figure 7-2. Clock Schematic (Sheet 2 of 2)

NOTES:

1. UNLESS OTHERWISE SPECIFIED:
   RESISTANCE VALUES ARE IN OHMS, ±5%, 1/4 W.
   CAPACITANCE VALUES ARE IN UF, ±20%, 50V.
   DIODES ARE IN4148

2. REFERENCE DESIGNATIONS ARE SHOWN FOR REFERENCE ONLY AND DO NOT NECESSARILY APPEAR ON PART.

3. RESISTOR R19 (SEE CIRCUIT 1 AND TABLE I) TO BE 1.2K, ±5%, 1/4 W.

5. INTEGRATED CIRCUIT TYPES ARE AS FOLLOWS:

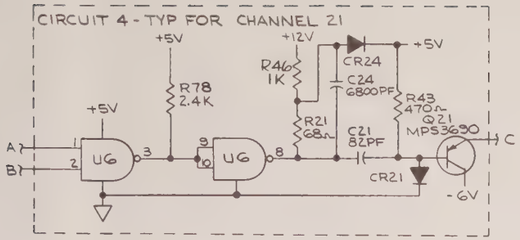
REF DES	U1 THRU U6	U7	U8	U9	U10
TYPE	SN74H01N	SN74H05N	SN74H04N	SN74121N	SN7476N

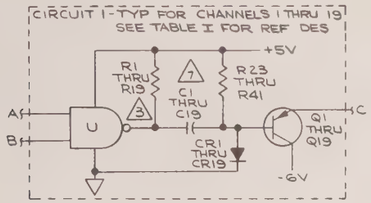
6. ONLY PARTIAL REFERENCE DESIGNATIONS ARE SHOWN. FOR COMPLETE DESIGNATION, PREFIX WITH A3.

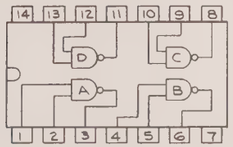
4. *C19 TO BE A SELECT AS REQUIRED BETWEEN 75 AND 120 PF. THE LOWER (H) THE VALUE THE LIGHTER THE GRID LINE.*

TABLE I: TABLE OF CORRESPONDING REF DESIGNATIONS FOR CIRCUIT 1

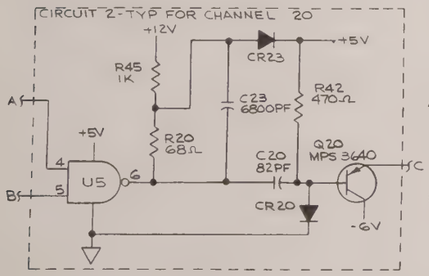
	4.7K ±5%, 1/4W	470Ω ±5%, 1/4W		120 PF ±10%, 500V		1N4148	MPS3640	SN74H01N
CHANNEL 7	R7	R29		C7		CR7	Q7	U2, PIN 11, 12, 13
8	R8	R30		C8		CR8	Q8	U2, PIN 8, 9, 10
3	R3	R25		C3		CR3	Q3	U1, PIN 11, 12, 13
4	R4	R26		C4		CR4	Q4	U1, PIN 8, 9, 10
5	R5	R27		C5		CR5	Q5	U1, PIN 4, 5, 6
6	R6	R28		C6		CR6	Q6	U1, PIN 1, 2, 3
1	R1	R23		C1		CR1	Q1	U2, PIN 1, 2, 3
2	R2	R24		C2		CR2	Q2	U2, PIN 4, 5, 6
9	R9	R31		C9		CR9	Q9	U3, PIN 11, 12, 13
10	R10	R32		C10		CR10	Q10	U3, PIN 8, 9, 10
11	R11	R33		C11		CR11	Q11	U3, PIN 4, 5, 6
12	R12	R34		C12		CR12	Q12	U3, PIN 1, 2, 3
13	R13	R35		C13		CR13	Q13	U4, PIN 11, 12, 13
14	R14	R36		C14		CR14	Q14	U4, PIN 8, 9, 10
15	R15	R37		C15		CR15	Q15	U4, PIN 4, 5, 6
16	R16	R38		C16		CR16	Q16	U4, PIN 1, 2, 3
17	R17	R39		C17		CR17	Q17	U5, PIN 11, 12, 13
18	R18	R40		C18		CR18	Q18	U5, PIN 8, 9, 10
CHANNEL 19	3 R19	R41		4 C19		CR19	Q19	U5, PIN 1, 2, 3

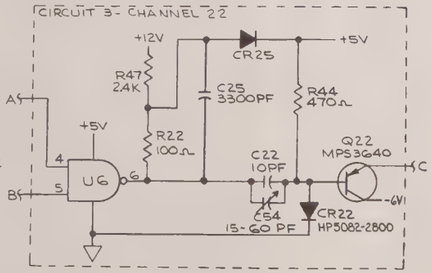






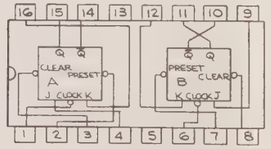
TOP VIEW
SN74H01N-U1 THRU U6
PIN 7 = GND
PIN 14 = +5V



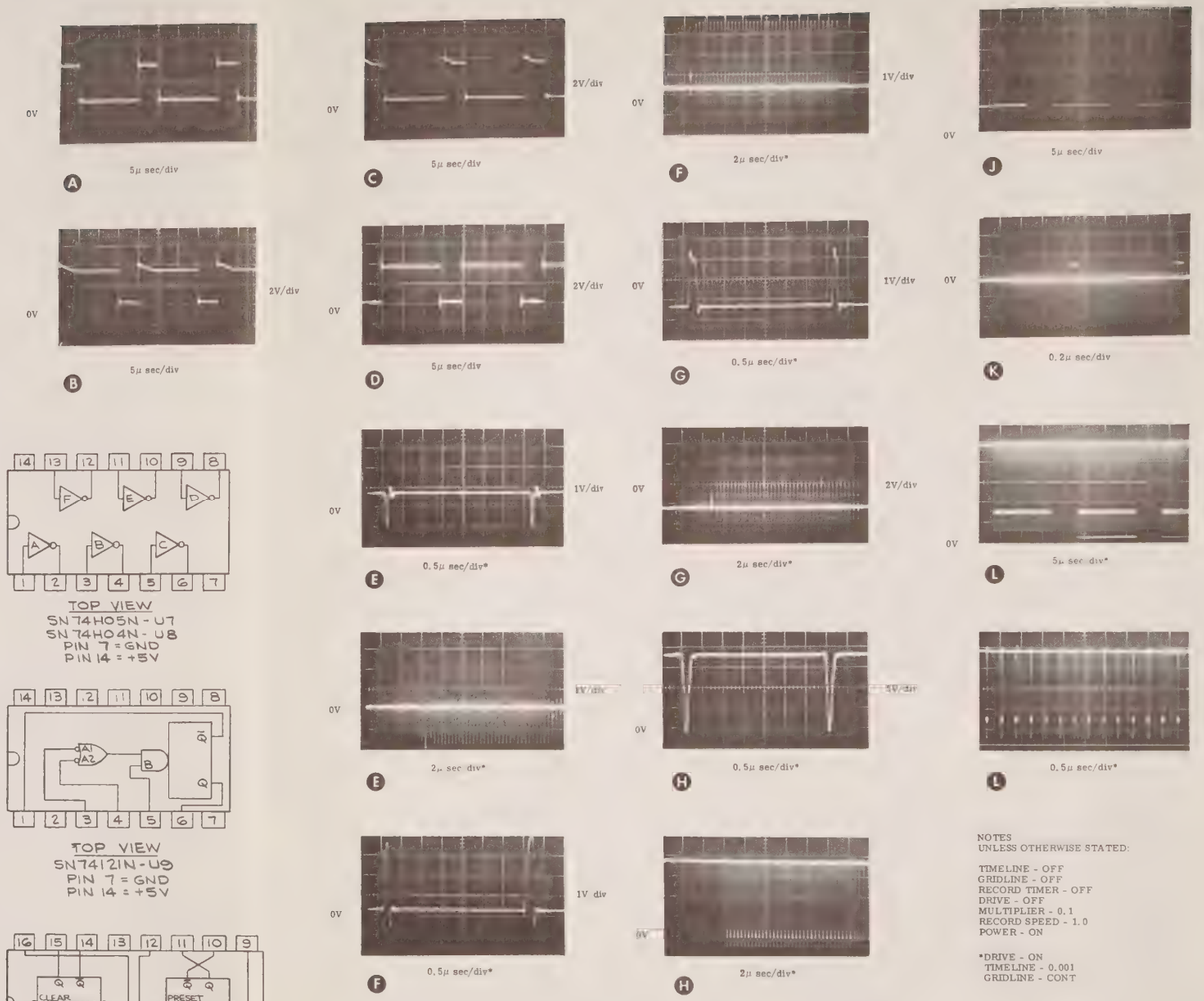


TOP VIEW
SN74H05N-U7
SN74H04N-U8
PIN 7 = GND
PIN 14 = +5V

TOP VIEW
SN74121N-U9
PIN 7 = GND
PIN 14 = +5V



TOP VIEW
SN7476N-U10
PIN 5 = +5V
PIN 13 = GND

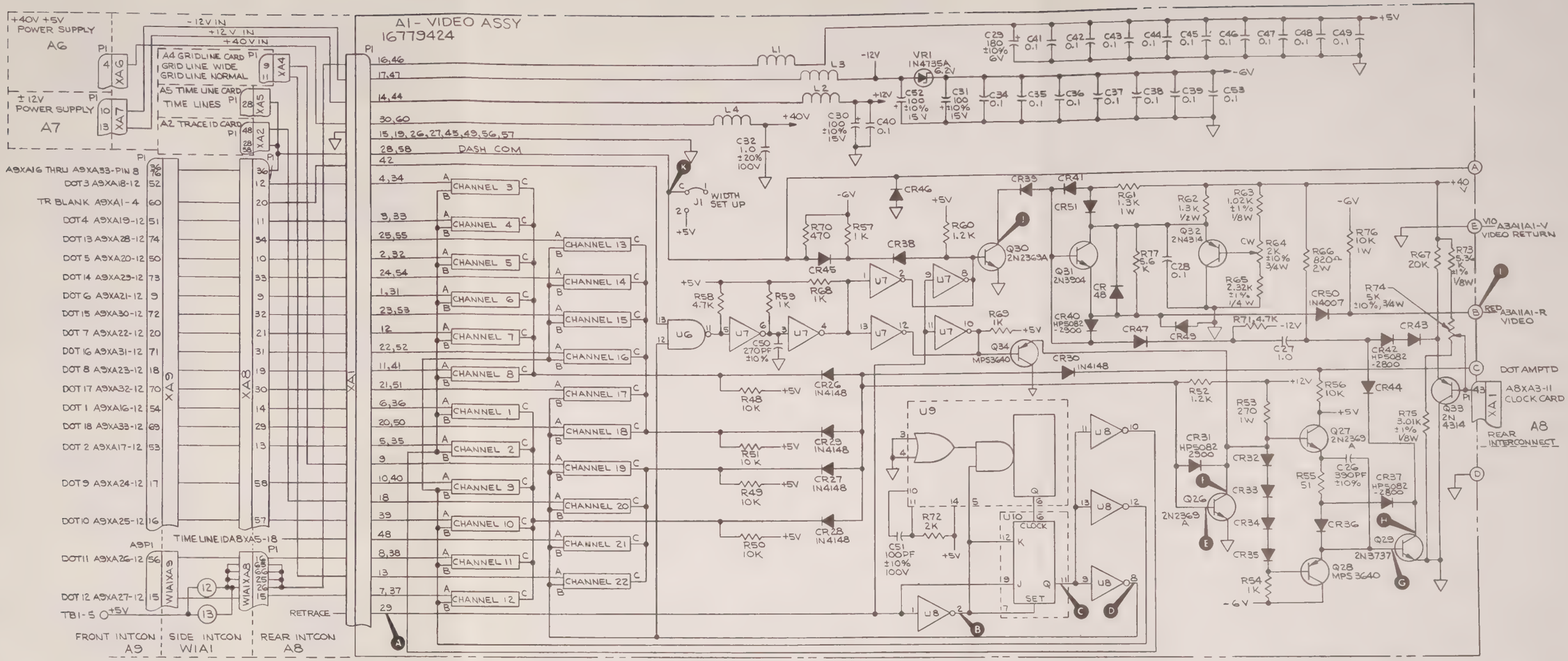


NOTES
UNLESS OTHERWISE STATED:

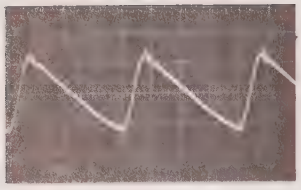
TIMELINE - OFF
GRIDLINE - OFF
RECORD TIMER - OFF
DRIVE - OFF
MULTIPLIER - 0.1
RECORD SPEED - 1.0
POWER - ON

*DRIVE - ON
TIMELINE - 0.001
GRIDLINE - CONT

Figure 7-3. Video Amplifier Schematic (Sheet 1 of 2)



REF 16779477-002 (H)
Figure 7-3. Video Amplifier Schematic (Sheet 2 of 2)



5μ sec/div

A

5μ sec/div

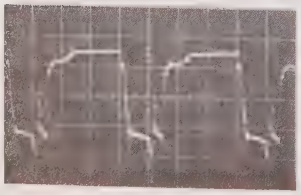
B

5μ sec/div

C

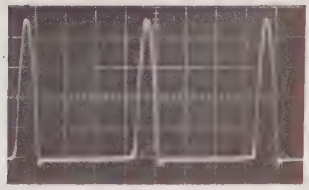
5μ sec/div

D



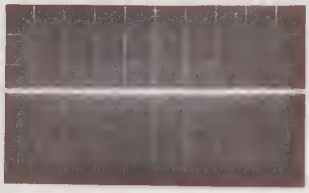
5μ sec/div

E



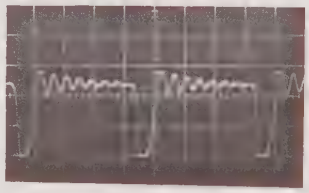
5μ sec/div

F



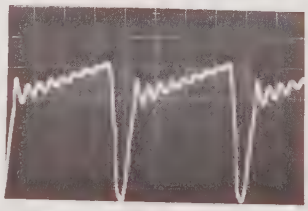
5μ sec/div

G



5μ sec/div

H

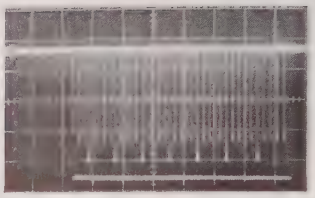


5μ sec/div

J

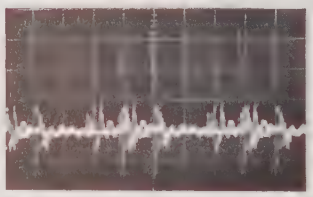
5μ sec/div

J



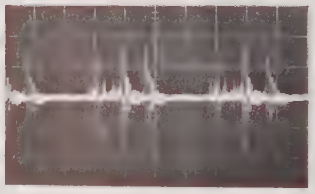
2μ sec/div
DRIVE - ON

K



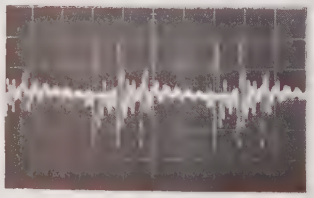
5μ sec/div

L



5μ sec/div

M



5μ sec/div

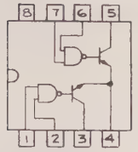
N

NOTES:
UNLESS OTHERWISE STATED:

TIMELINE - OFF
RECORD TIMER - OFF
GRIDLINE - OFF
DRIVE - OFF
MULTIPLIER - 0.1
POWER - ON
RECORD SPEED - 1.0
*AC COUPLED

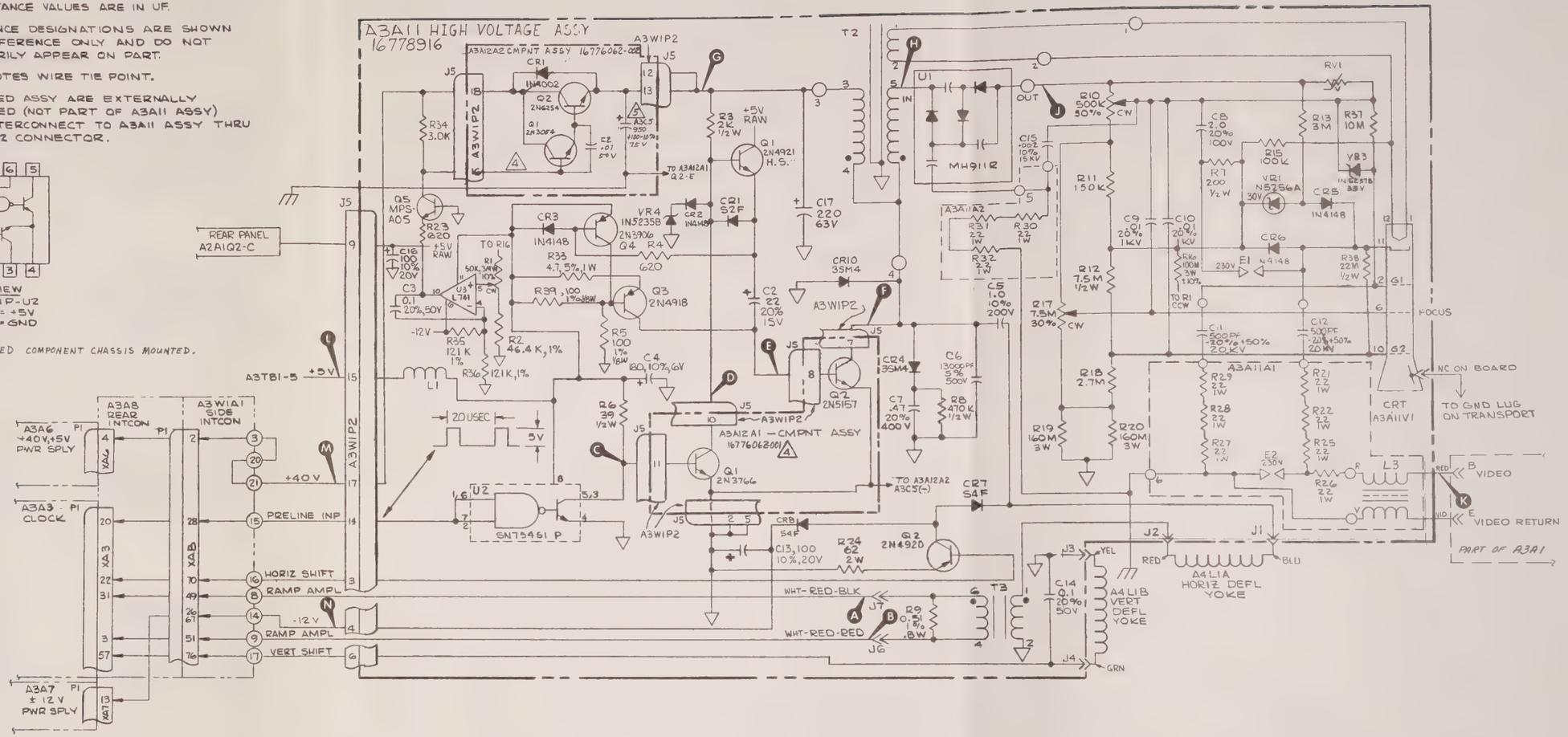
NOTES:

1. UNLESS OTHERWISE SPECIFIED, RESISTANCE VALUES ARE IN OHMS, 5%, 1/4 W. CAPACITANCE VALUES ARE IN UF.
2. REFERENCE DESIGNATIONS ARE SHOWN FOR REFERENCE ONLY AND DO NOT NECESSARILY APPEAR ON PART.
3. ○ DENOTES WIRE TIE POINT.
4. INDICATED ASSY ARE EXTERNALLY MOUNTED (NOT PART OF A3A11 ASSY) AND INTERCONNECT TO A3A11 ASSY THRU A3WIP2 CONNECTOR.



TOP VIEW
SN75451P-U2
PIN 8 = +5V
PIN 4 = GND

5. INDICATED COMPONENT CHASSIS MOUNTED.

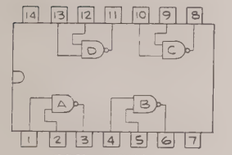


REF 16778940 (A)
Figure 7-4. High Voltage Schematic

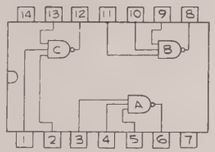
NOTES:

1. UNLESS OTHERWISE SPECIFIED:
   RESISTANCE VALUES ARE IN OHMS, ± 1%, 1/4 W.
   CAPACITANCE VALUES ARE IN UF, ±10%, 15 V.
   DIODES ARE IN4148.
2. REFERENCE DESIGNATIONS ARE SHOWN FOR REFERENCE ONLY AND DO NOT APPEAR ON PART.
3. ONLY PARTIAL REFERENCE DESIGNATIONS ARE SHOWN. FOR COMPLETE DESIGNATION, PREFIX WITH A3.
4. INDICATED DESIGNATIONS ARE COMPLETE.
5. ▭ DENOTES PANEL NOMENCLATURE.
6. PINS 1,2,3,4,5,12, 13,18, 19,20,21, 22,23 24,25 27,29,30,31 32,33,34,35,36 37,38 39 41,42,43 48 49 50,51,52,53 54 55, 57, 59 AND 60 ARE ALSO GROUND BUT ARE NOT SHOWN.

TOP VIEW
LM-306H-U12
PIN 8 = +12V
PIN 4 = -12V

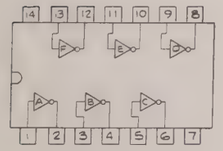


TOP VIEW
SN7400N-U4,6
PIN 14 = +5V
PIN 7 = GND

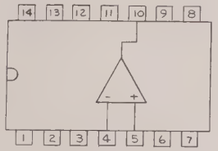


TOP VIEW
SN7410N-U7,14
PIN 14 = +5V
PIN 7 = GND

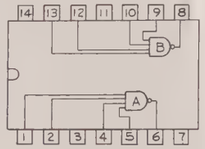
BOTTOM VIEW
CA3039 CR1,2



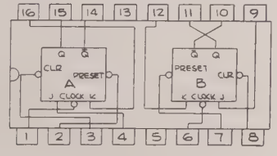
TOP VIEW
SN7404N-U5
PIN 14 = +5V
PIN 7 = GND



TOP VIEW
L741-1 -U11,13
PIN 11 = +12V
PIN 6 = -12V



TOP VIEW
SN7440N-U8
PIN 14 = +5V
PIN 7 = GND



TOP VIEW
SN7476N-U1,2,3,9,10,15
PIN 5 = +5V
PIN 13 = GND

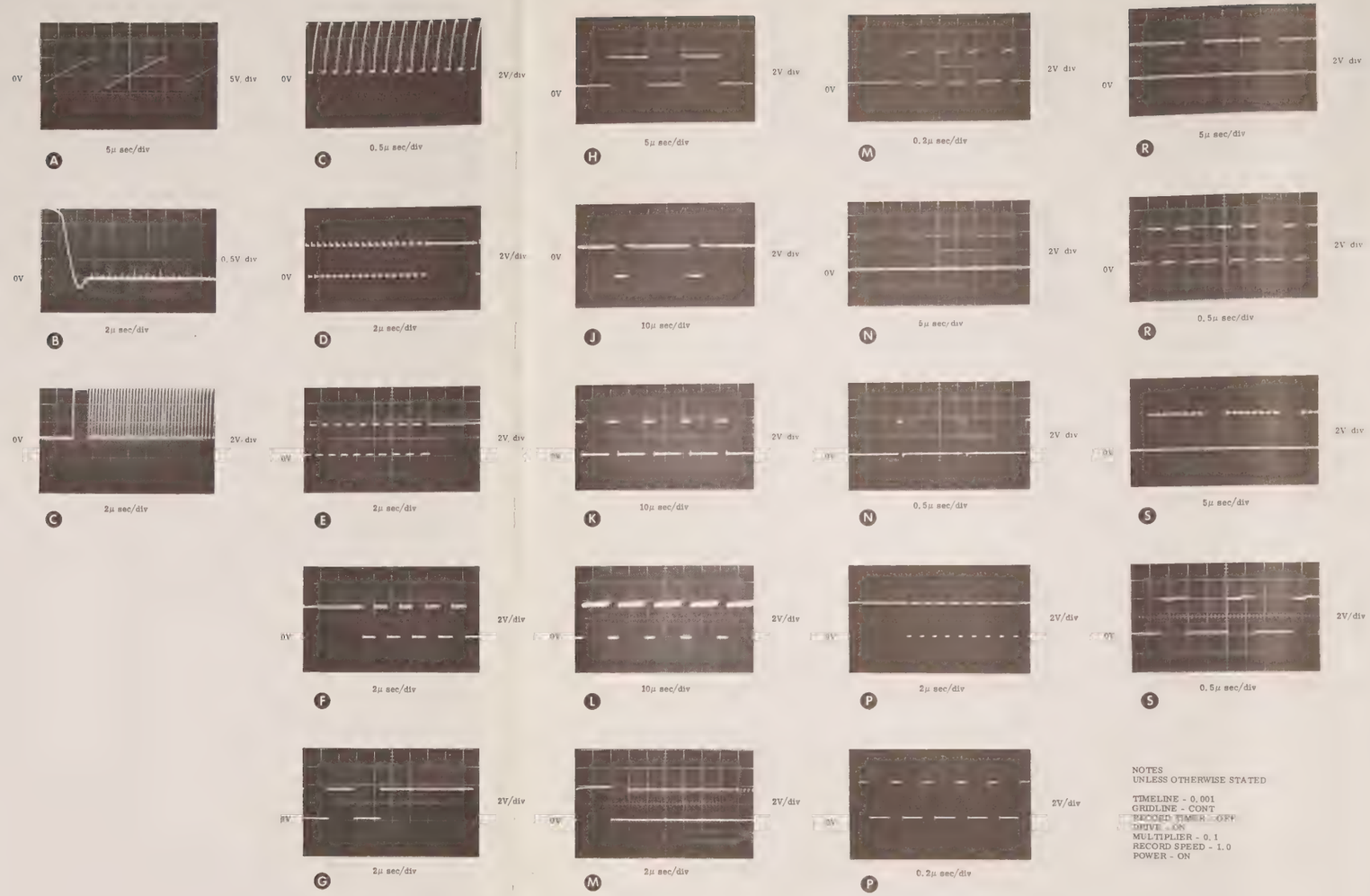
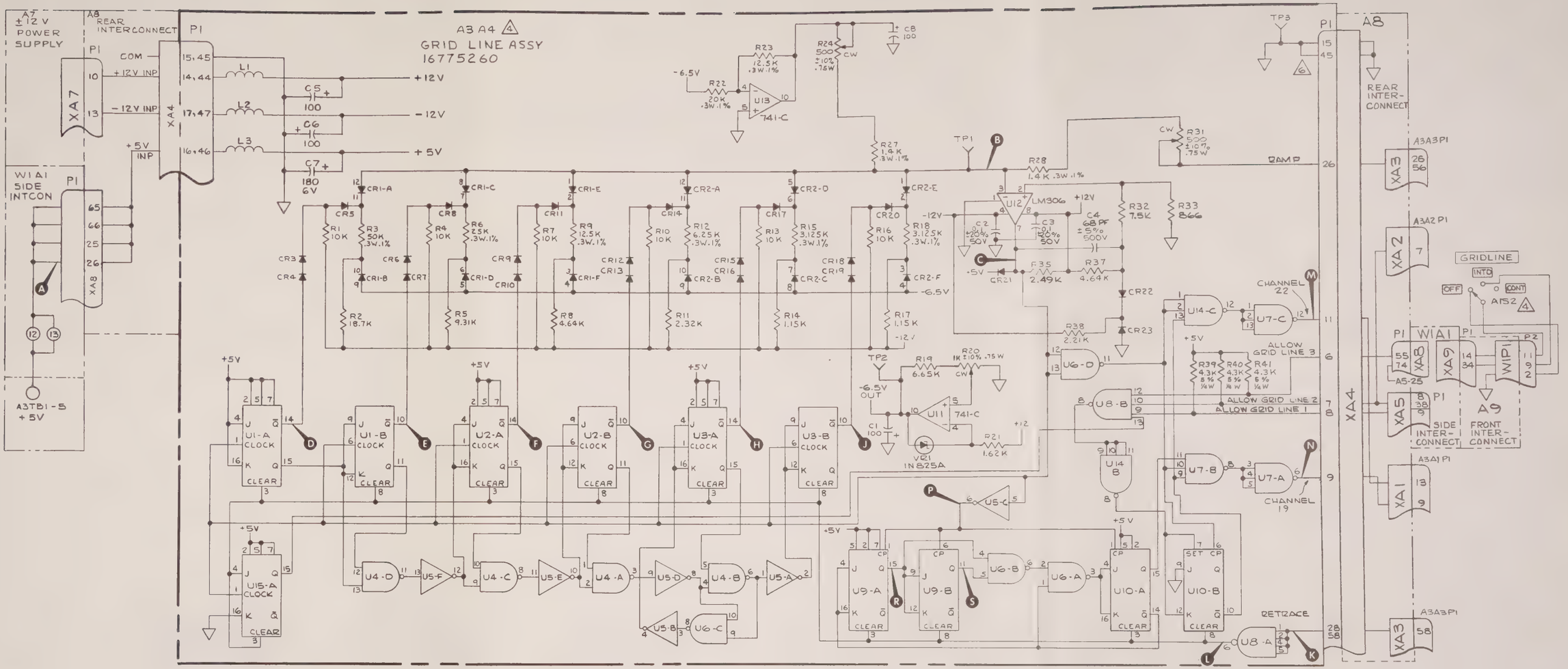


Figure 7-5. Gridline Generator Schematic
(Sheet 1 of 2)



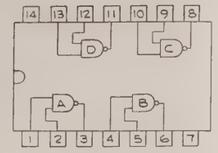
REF 16775261(C)

Figure 7-5. Gridline Generator Schematic (Sheet 2 of 2)

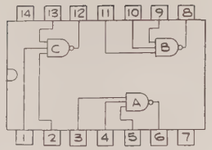
NOTES:

1. UNLESS OTHERWISE SPECIFIED:
   RESISTANCE VALUES ARE IN OHMS, ±5%, 1/4 W.
   CAPACITANCE VALUES ARE IN UF, ±5%, 500V.
   DIODES ARE IN4148.
   TRANSISTORS ARE 2N3904.
2. REFERENCE DESIGNATIONS ARE SHOWN FOR REFERENCE ONLY AND DO NOT APPEAR ON PART.
3. ONLY PARTIAL REFERENCE DESIGNATIONS ARE SHOWN. FOR COMPLETE DESIGNATION, PREFIX WITH A3.
4. INDICATED DESIGNATIONS ARE COMPLETE.
5. ▭ DENOTES PANEL NOMENCLATURE.
6. 11-13, 19-24, 39-43, 48-54, ARE GROUND ALSO.

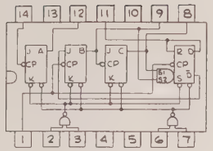
TOP VIEW
LM 301A - U26
PIN 7 = +12V
PIN 4 = -12V



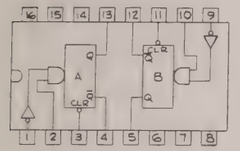
TOP VIEW
SN7400N - U1, 2, 6, 7, 11
U12, 21, 23
PIN 14 = +5V
PIN 7 = GND
SPARE GATES = U6-D, U12-C



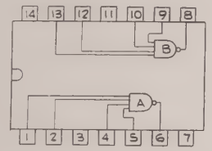
TOP VIEW
SN7410N - U5, 9, 25
PIN 14 = +5V
PIN 7 = GND
SPARE GATES = U9-C, U25-B



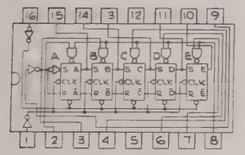
TOP VIEW
SN7490 N - U3, 4, 8, 13
U17, 20, 22
PIN 5 = +5V
PIN 10 = GND



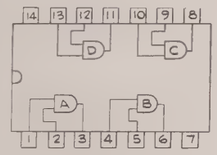
TOP VIEW
SN74123N - U14, 9
PIN 16 = +5V
PIN 8 = GND



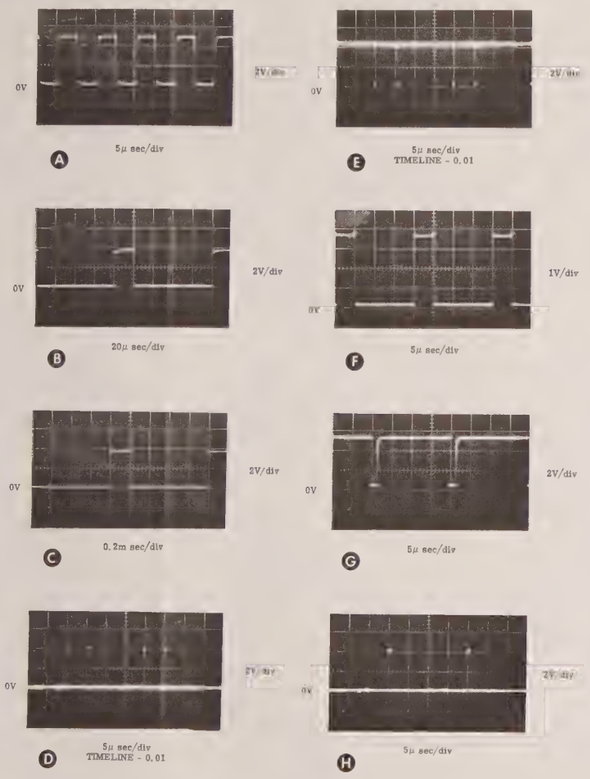
TOP VIEW
SN7440N - U15
PIN 14 = +5V
PIN 7 = GND

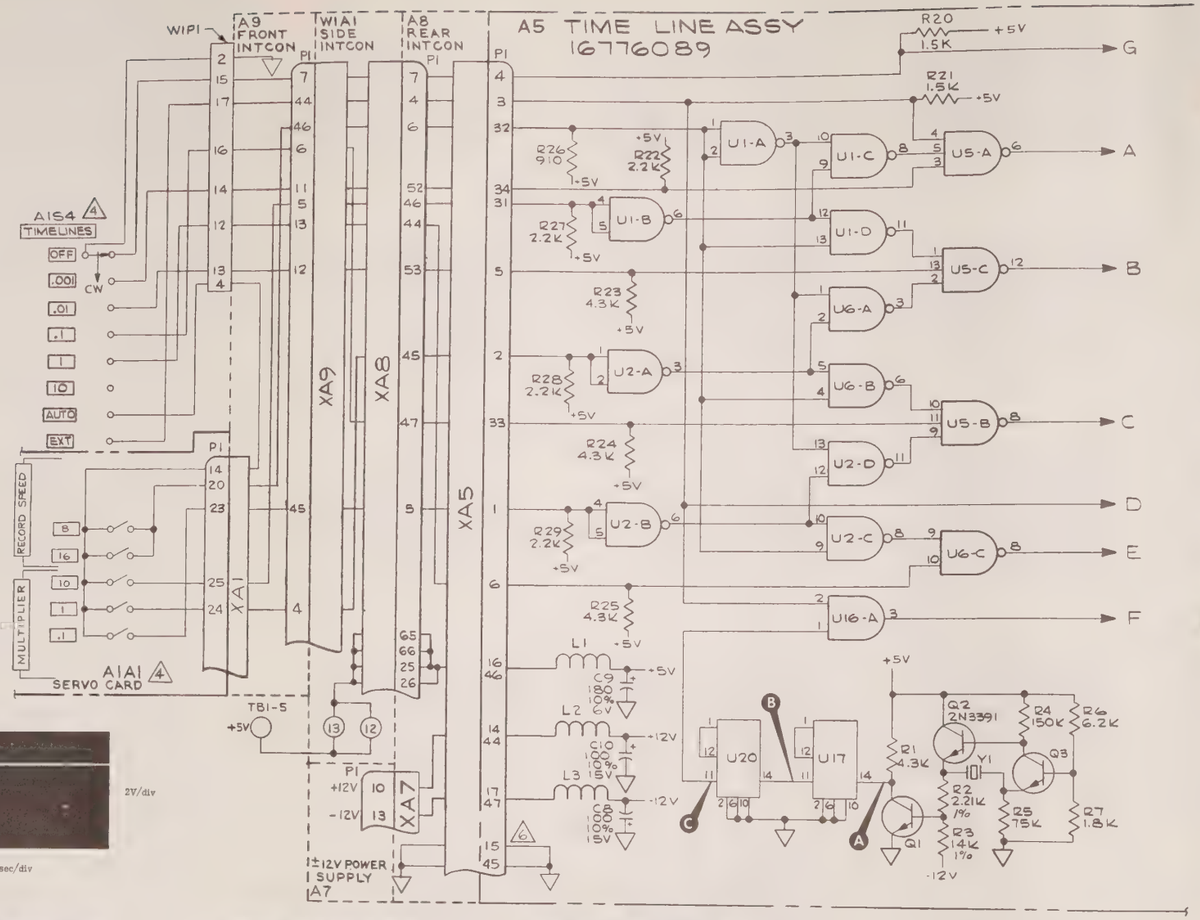


TOP VIEW
SN7496N - U10, 24
PIN 5 = +5V
PIN 12 = GND



TOP VIEW
SN7408N - U16, 18
PIN 14 = +5V
PIN 7 = GND
SPARE GATES = U16-C, U18-C

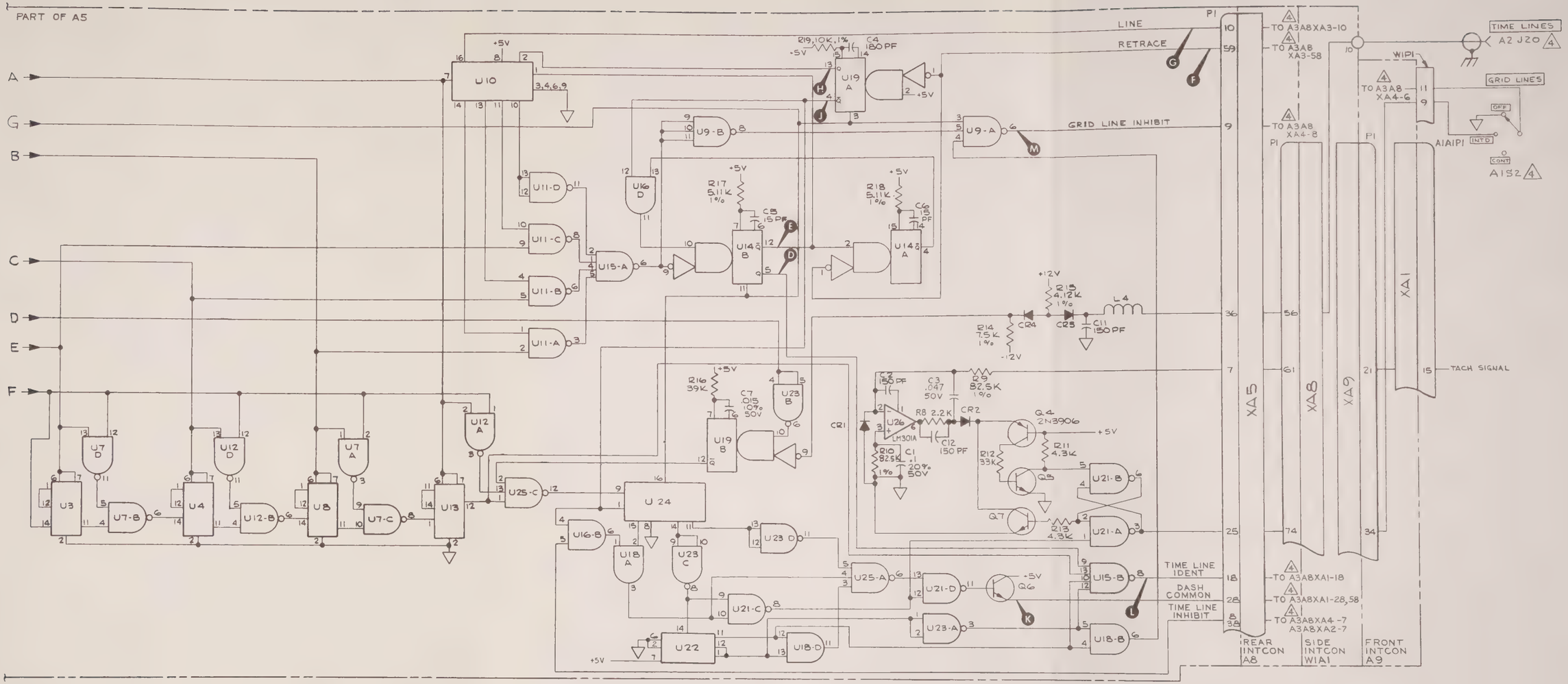




NOTES
UNLESS OTHERWISE STATED

TIMELINE - 0.001
GRIDLINE - CONT
RECORD TIMER - OFF
DRIVE - ON
MULTIPLIER - 0.1
RECORD SPEED - 1.0
POWER - ON

Figure 7-6. Timeline Generator Schematic (Option) (Sheet 1 of 2)



REF 16776090(D)
Figure 7-6. Timeline Generator Schematic (Option) (Sheet 2 of 2)

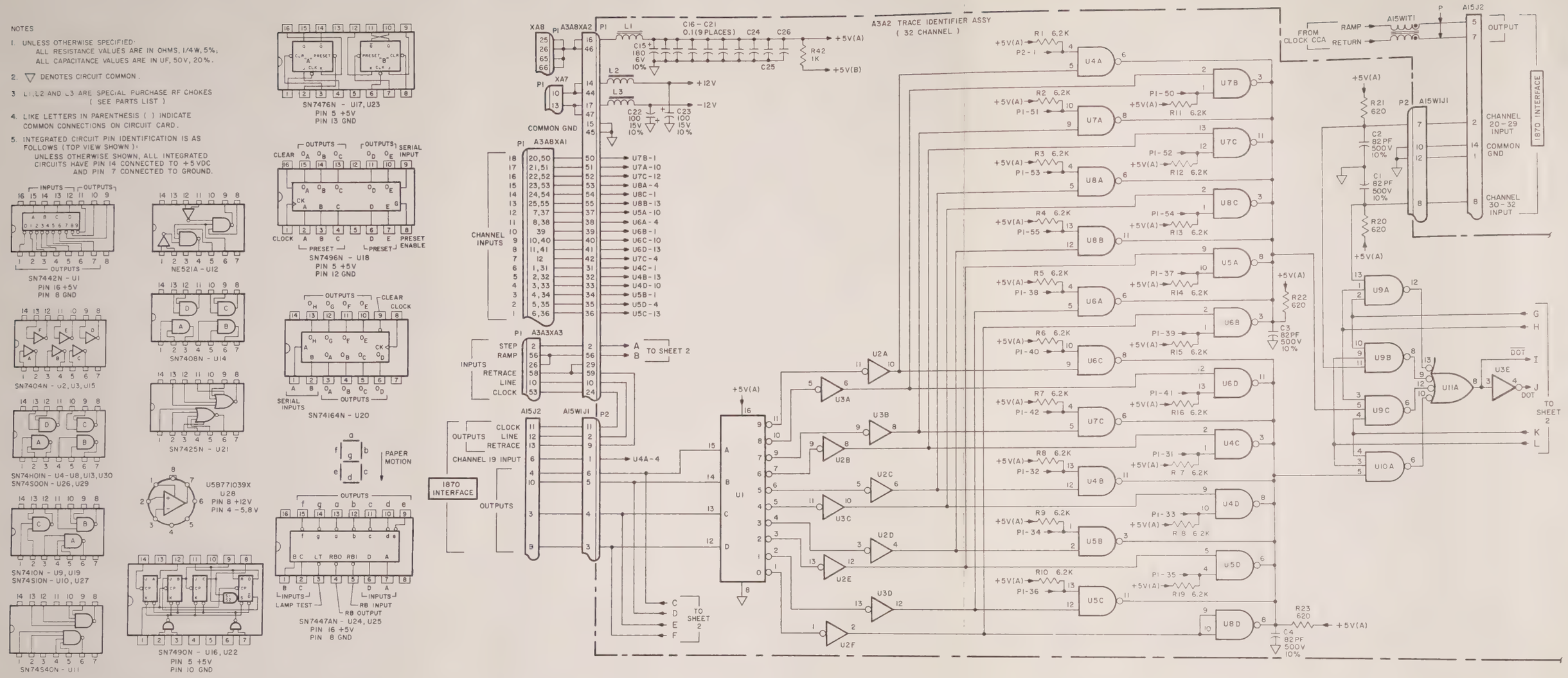
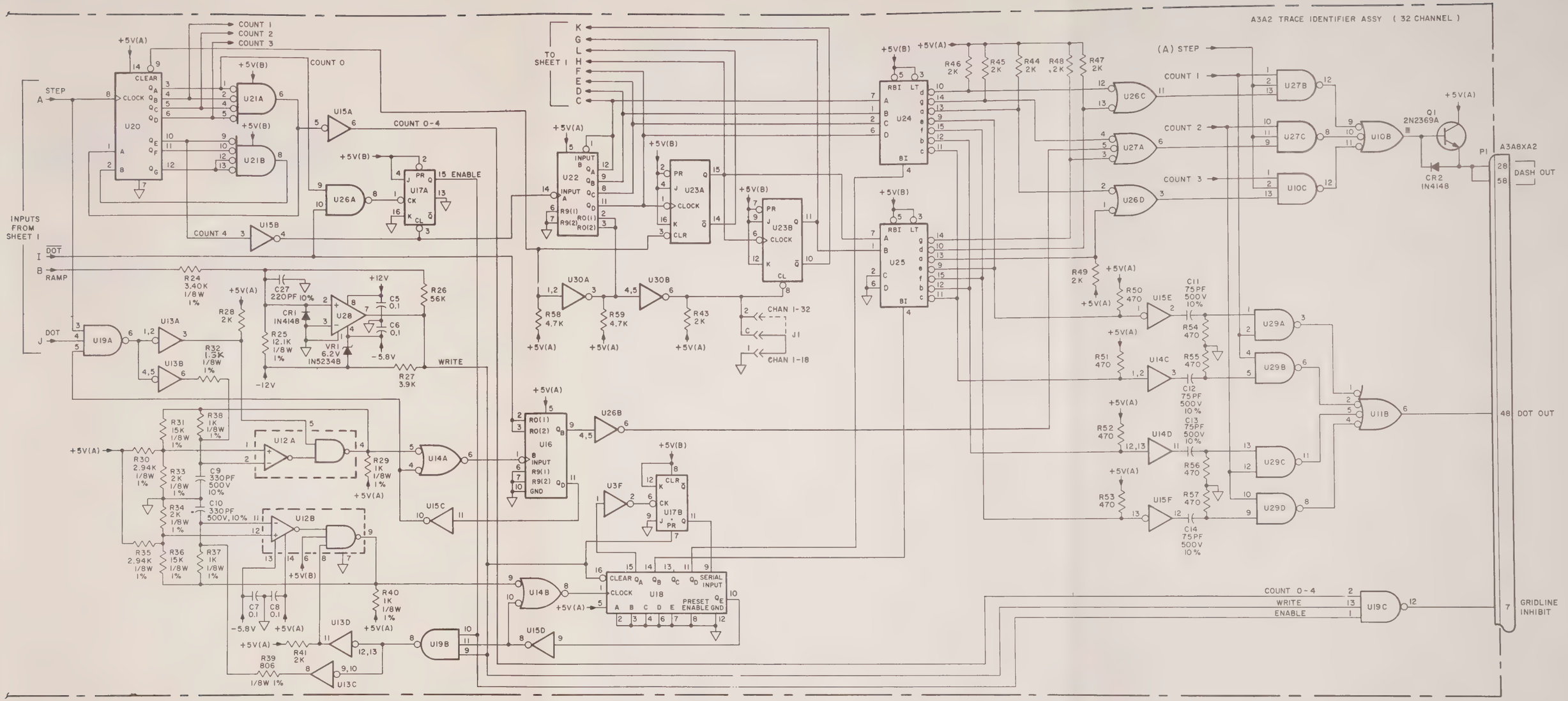


Figure 7-7. Trace Identifier Schematic (Option)
(Sheet 1 of 2)



REF 16779868(D)

Figure 7-7. Trace Identifier Schematic (Option) (Sheet 2 of 2)

NOTES:

1. UNLESS OTHERWISE SPECIFIED:
   RESISTANCE VALUES ARE IN OHMS, ±1%, 1/4 W.

   CAPACITANCE VALUES ARE IN UF, ±20%, 50 V.

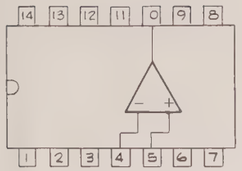
   DIODES ARE IN4148.

   ZENER DIODES ARE IN5234B, 6.2V.

2. ONLY PARTIAL REFERENCE DESIGNATIONS ARE SHOWN. FOR COMPLETE DESIGNATION, DESIGNATION, PREFIX WITH A3, EXCEPT AS NOTED.

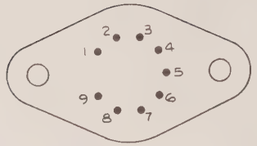
3. INDICATED REFERENCE DESIGNATIONS ARE COMPLETE DESIGNATIONS.

4. ○ INDICATES WIRE TIE POINT ON CIRCUIT CARD ASSY



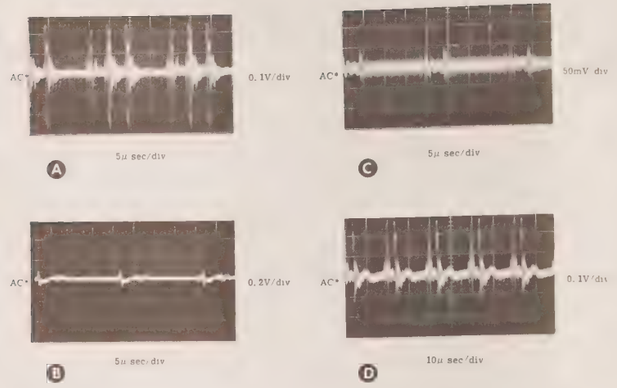
TOP VIEW
L741
A6U3
A7U3, U4
PIN 7 = GND
PIN 11 = +Vcc
PIN 6 = -Vcc
PIN 4 = INVERTING INPUT
PIN 5 = NON-INVERTING INPUT
PIN 3, PIN 9 = OFF-SET NULL
PIN 10 = OUTPUT

TOP VIEW
MC1466L A6U1
PIN 1 =
PIN 2 = CURRENT SET
PIN 3 = CURRENT SOURCE
PIN 4 = CURRENT SET
PIN 5 = OUTPUT
PIN 6 = COMPENSATION
PIN 7 = -Vaux
PIN 8 = VOLTAGE SENSE INPUT
PIN 9 = VOLTAGE SENSE INPUT
PIN 10 = CURRENT SENSE INPUT
PIN 11 = CURRENT SENSE INPUT
PIN 12 = INTERNAL REGULATED VOLTAGE
PIN 13 = INTERNAL COMPENSATION
PIN 14 = +Vaux



BOTTOM VIEW
MC1463R, A7U2
PIN 1 = DC SHIFT SENSE
PIN 2 = SHUT DOWN CONTROL
PIN 3 = NOISE FILTER
PIN 4 = VIN
PIN 5 = CURRENT LIMIT
PIN 6 = Vout
PIN 7 = COMPENSATION
PIN 8 = OUTPUT SENSE
PIN 9 = DC SHIFT OUTPUT
CASE = GROUND

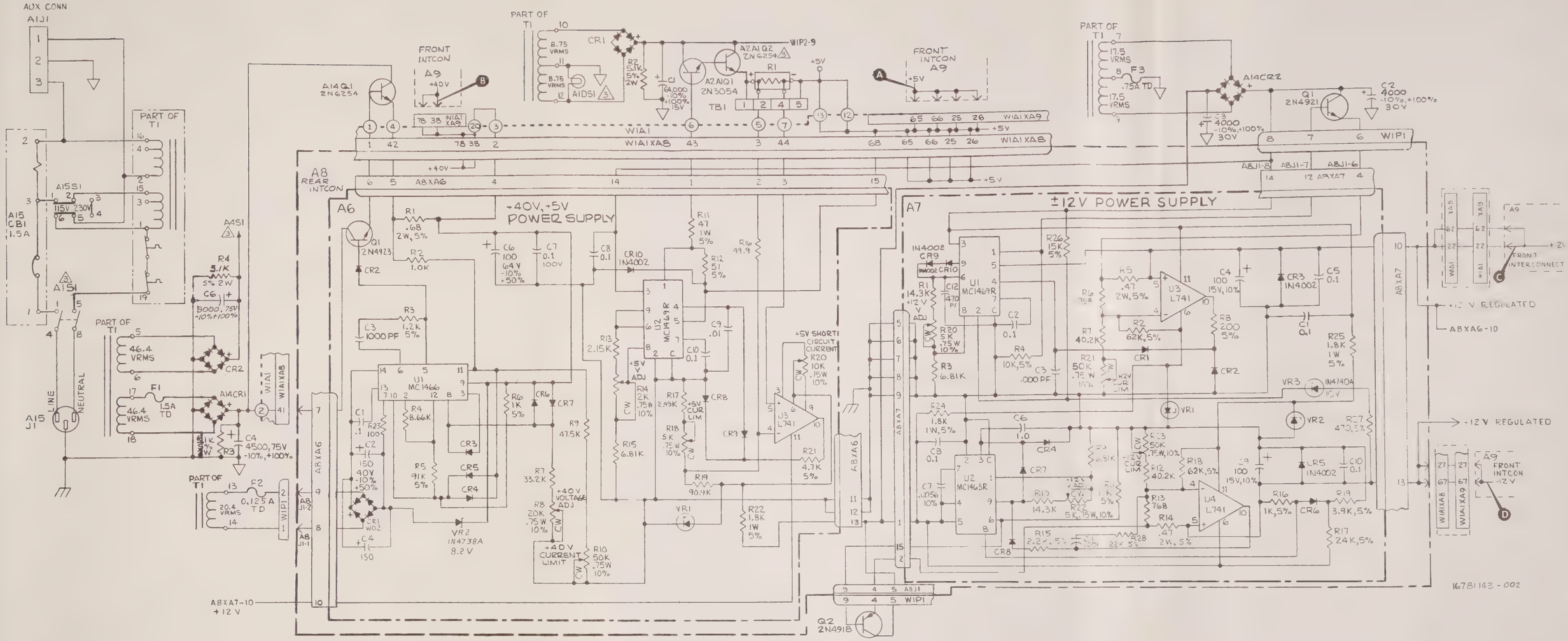
MC1469R, A6U2, A7U1
SAME OUTLINE AND PIN DESIGNATIONS AS MC1463R, EXCEPT FOR FOLLOWING PIN NOMENCLATURE:
PIN 1 = OUTPUT
PIN 2 = SHUTDOWN CONTROL
PIN 3 = +VIN
PIN 4 = COMPENSATION AND CURRENT LIMIT
PIN 5 = OUTPUT SENSE
PIN 6 = OUTPUT REFERENCE
PIN 7 = NOISE FILTER
PIN 8 = DC SHIFT SENSE
PIN 9 = DC SHIFT OUTPUT
CASE = GROUND



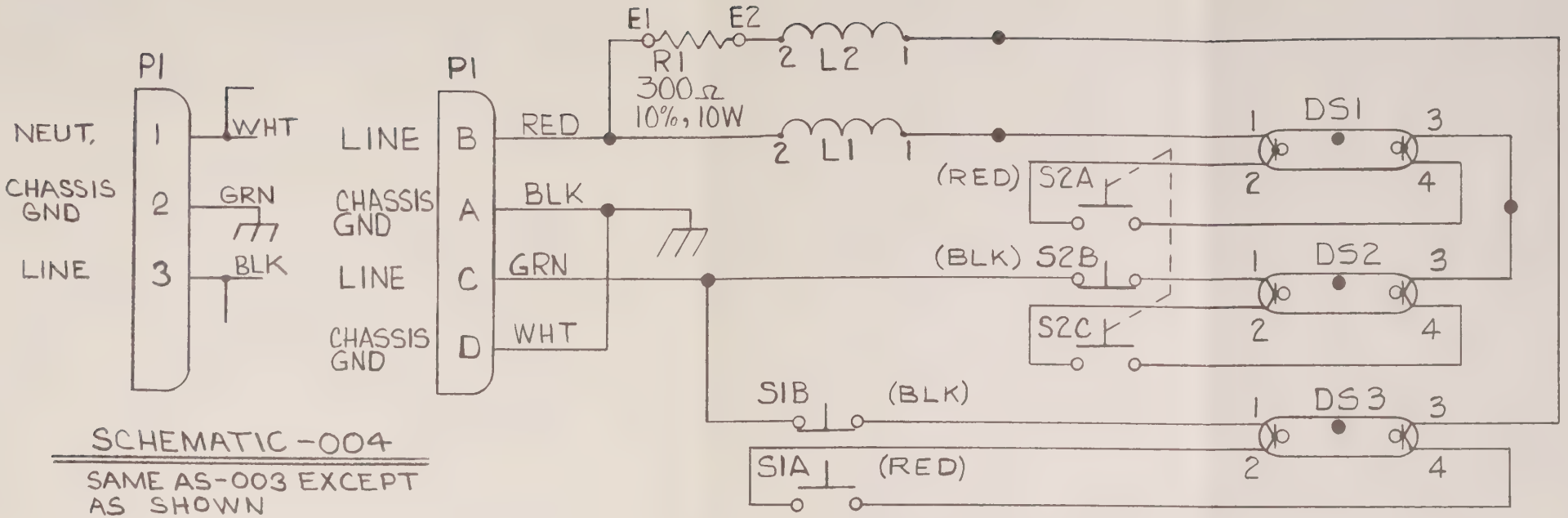
NOTES
UNLESS OTHERWISE STATED:
*AC COUPLED

16781143-1A

Figure 7-8. Power Supply Schematic (Sheet 1 of 2)



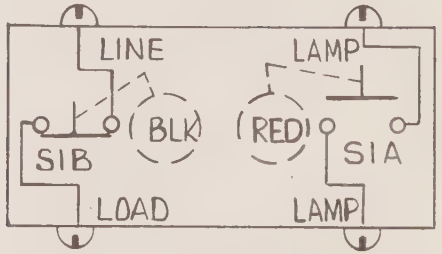
REF 16781143(J)
Figure 7-8. Power Supply Schematic (Sheet 2 of 2)



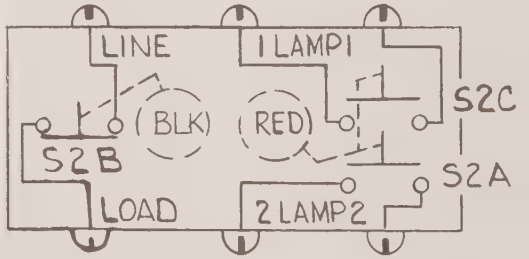
SCHEMATIC -004

SAME AS-003 EXCEPT AS SHOWN

SCHEMATIC-003



S1, BOTTOM VIEW



S2, BOTTOM VIEW

REF 16775753 (W)
Figure 7-9. Latensifier Schematic -004

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MODEL 1858

Honeywell Part Number 16781227-001R

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